



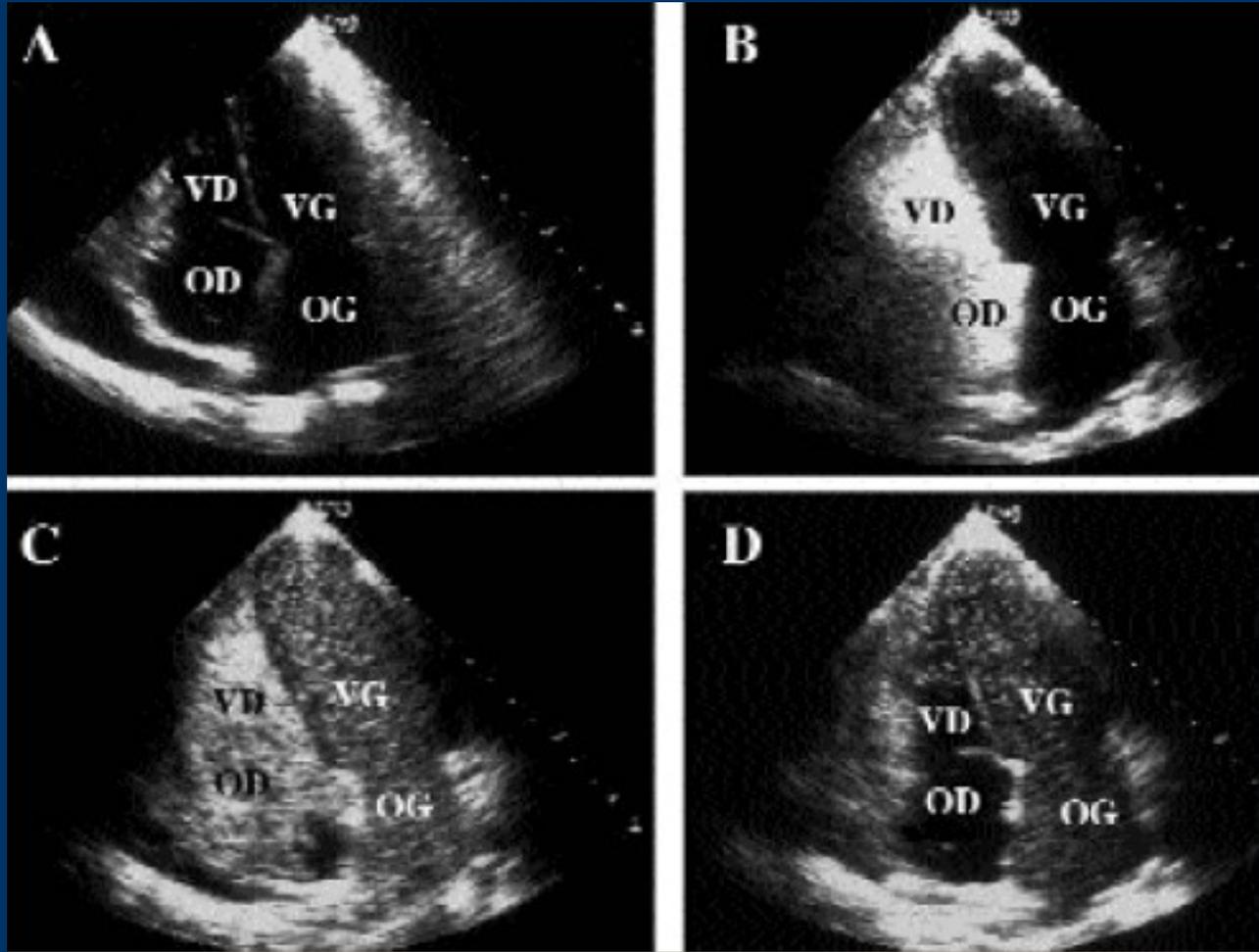
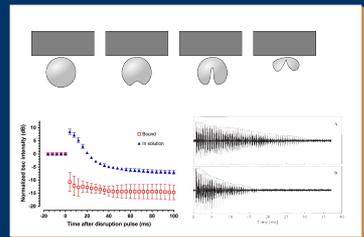
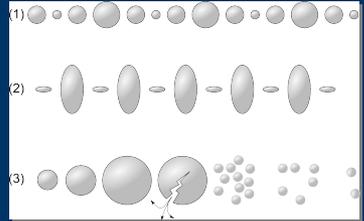
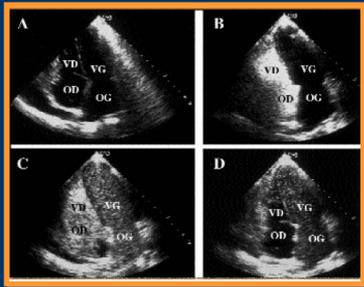
Destruction de microbulles par ultrasons

Pol Grasland-Mongrain,
sous la direction d'Olivier Couture et de Mickaël Tanter

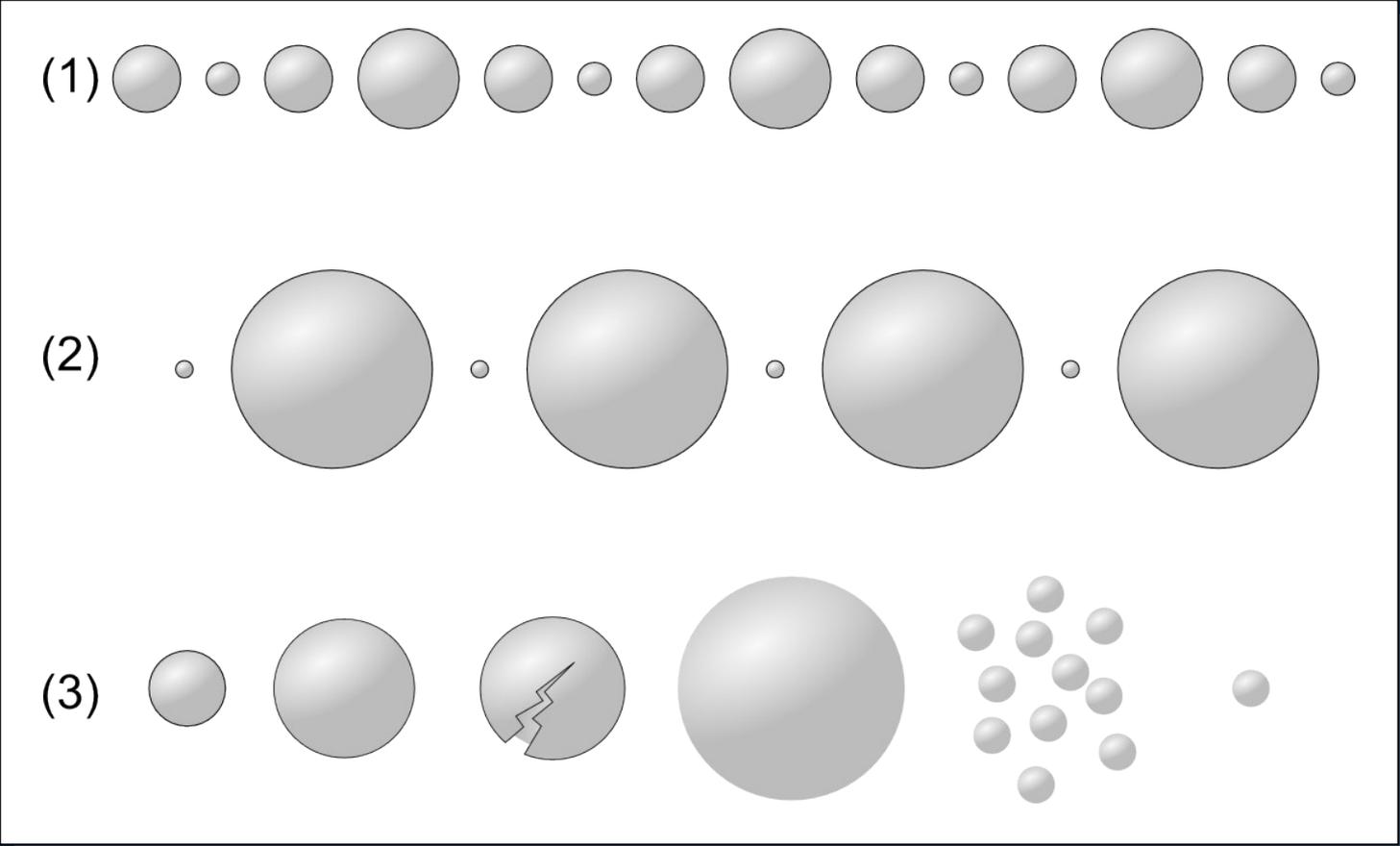
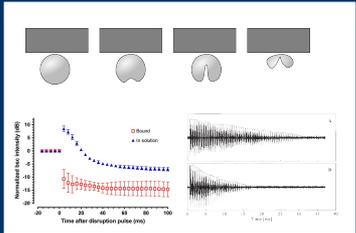
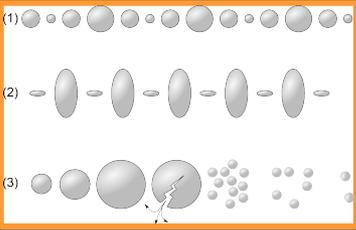
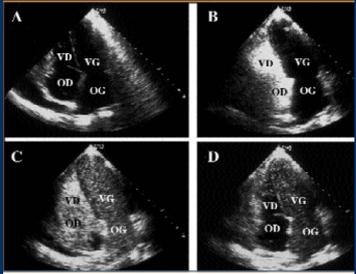
Institut Langevin « Onde et Images »
ESPCI ParisTech, 10 rue Vauquelin, 75005 Paris

15 février 2010 – 15 juillet 2010

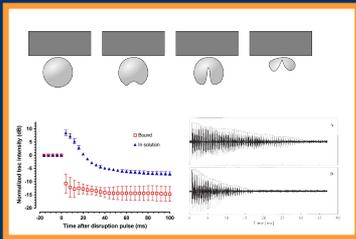
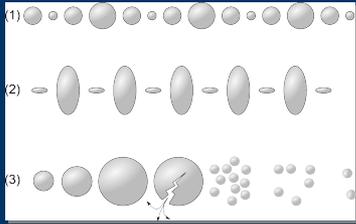
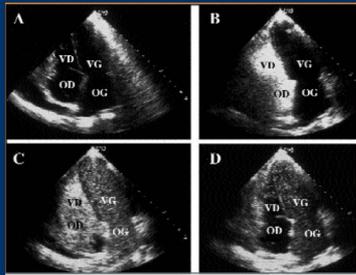
Les microbulles sont utilisées comme agent de contraste en imagerie ultrasonore.



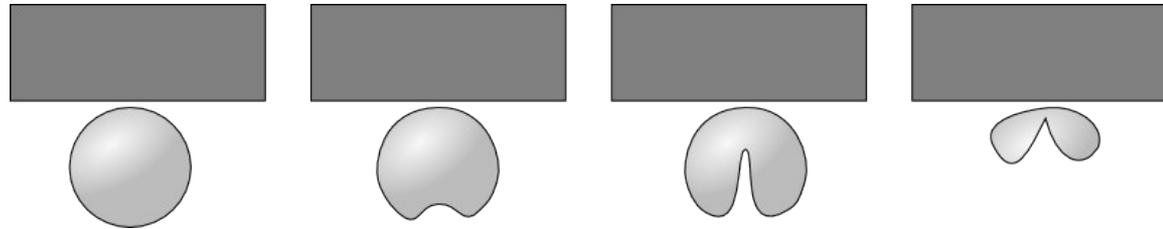
Selon la pression des ultrasons, on a des oscillations **linéaires** (1), **non-linéaires** (2), ou une **implosion** (3).



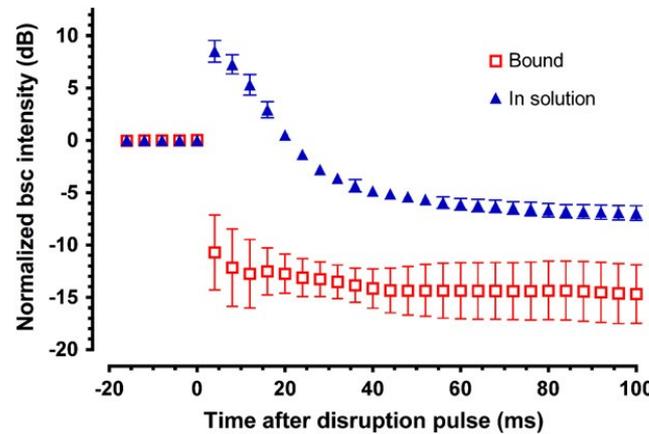
L'environnement des microbulles influence leur destruction : paroi (1), ciblage (2) , pression (3)...



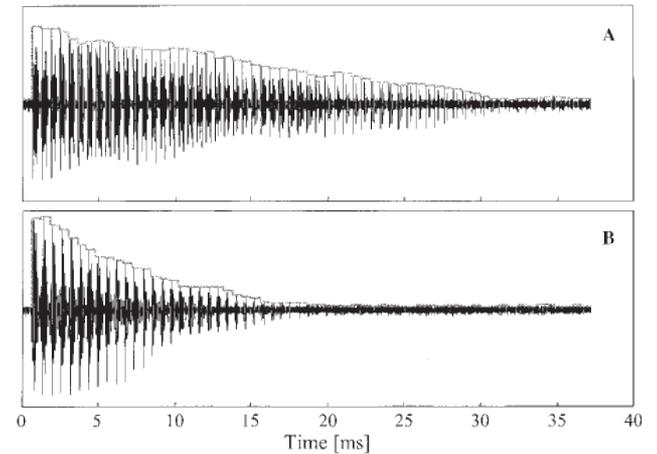
(1) Noltingsk et al. (1950), Vos et al. (2007) :



(2) Couture et al. (2009)



(3) Bouakaz et al. (1999)

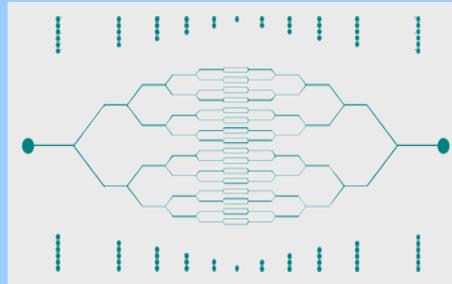


Comment utiliser la destruction des microbulles comme senseurs de leur environnement ?

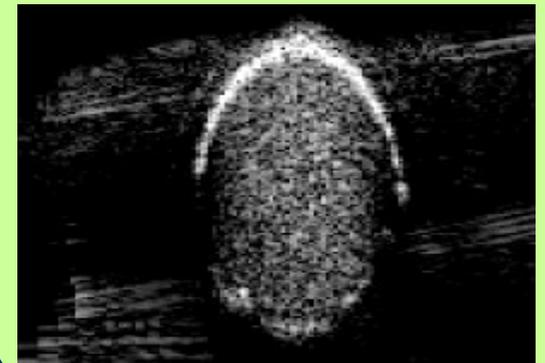
Ciblage des microbulles



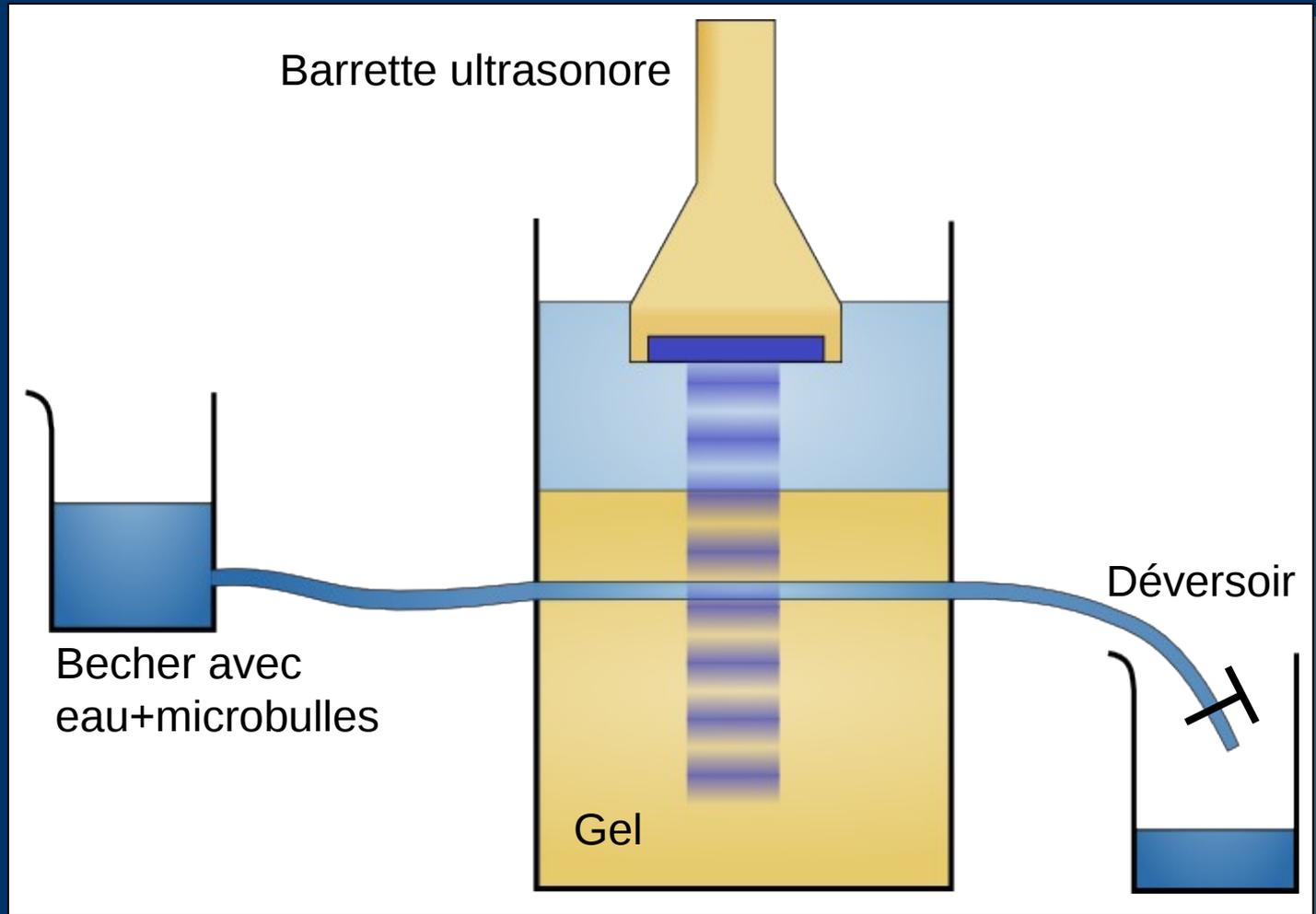
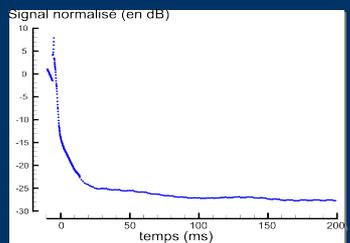
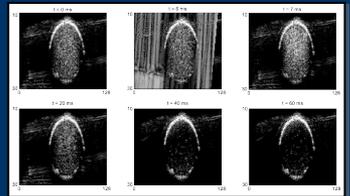
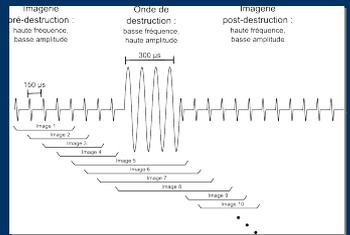
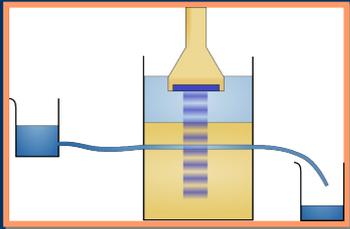
Confinement dans des microcanaux



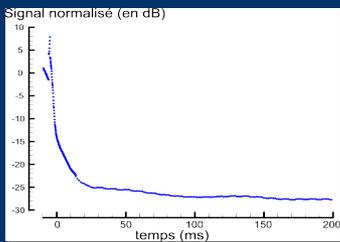
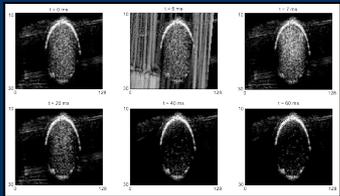
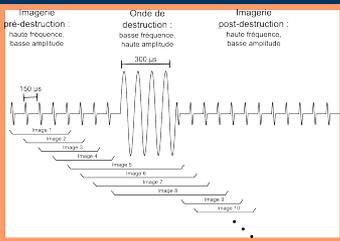
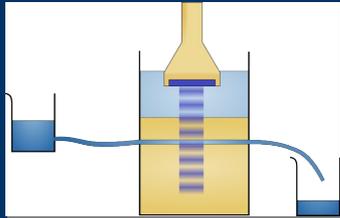
Influence de la pression



Protocole pour la destruction de microbulles avec augmentation de signal.



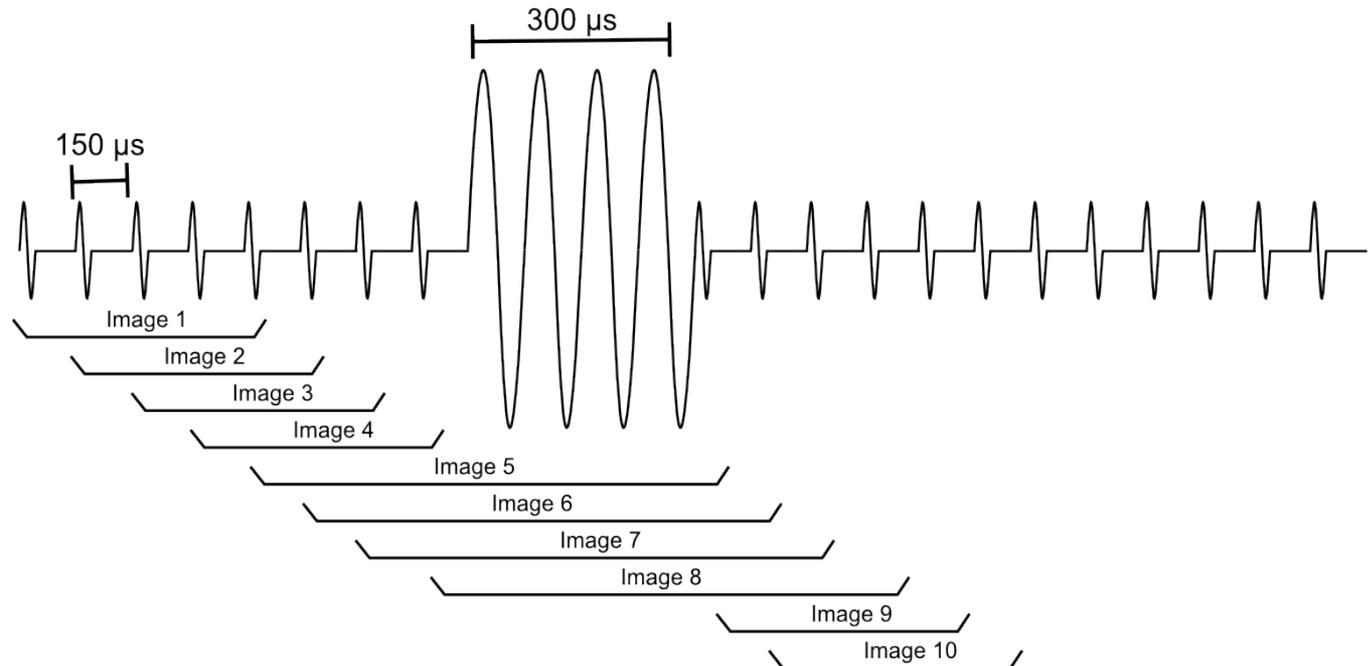
Protocole pour la destruction de microbulles avec augmentation de signal.



Imagerie pré-destruction :
haute fréquence,
basse amplitude

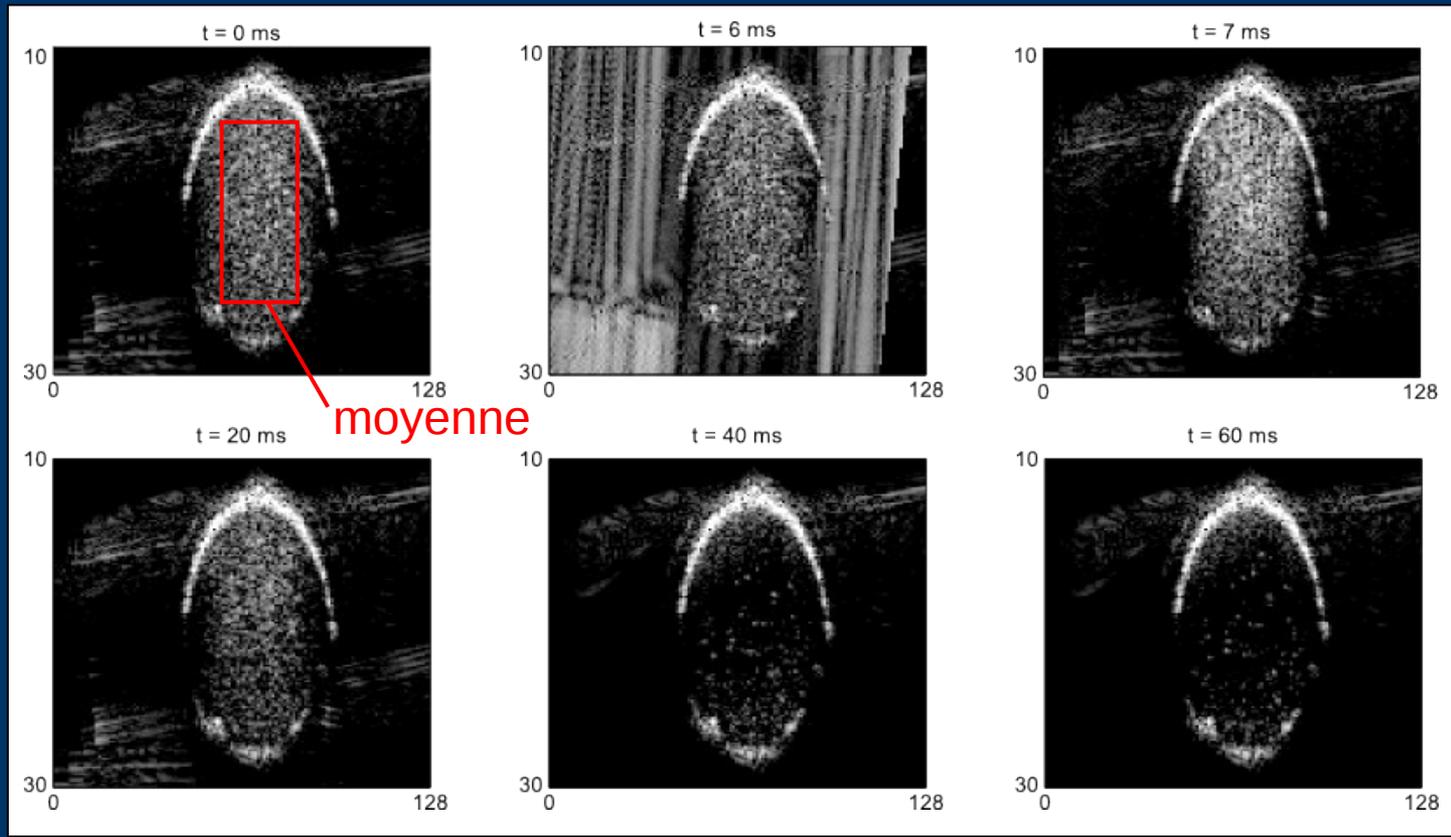
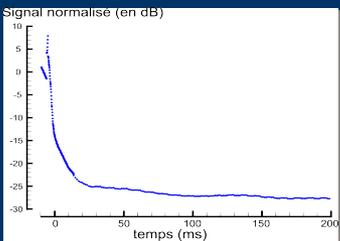
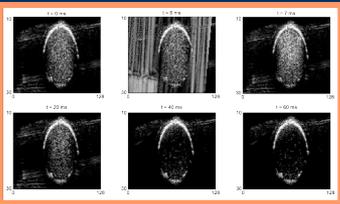
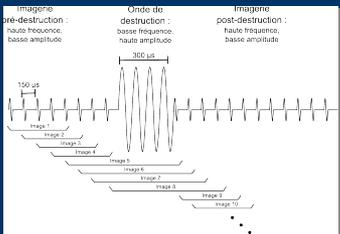
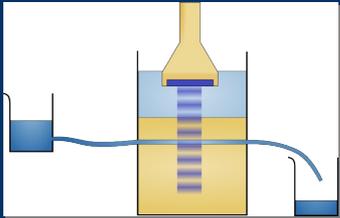
Onde de destruction :
basse fréquence,
haute amplitude

Imagerie post-destruction :
haute fréquence,
basse amplitude

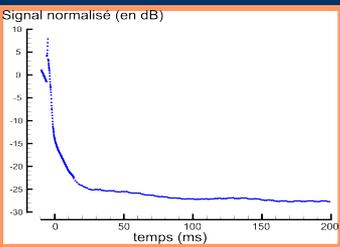
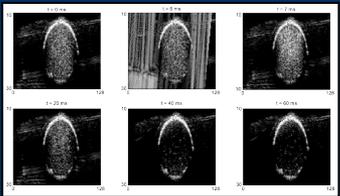
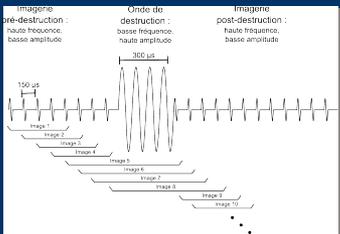
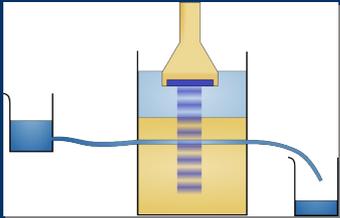


Technique Ultrafast Imaging

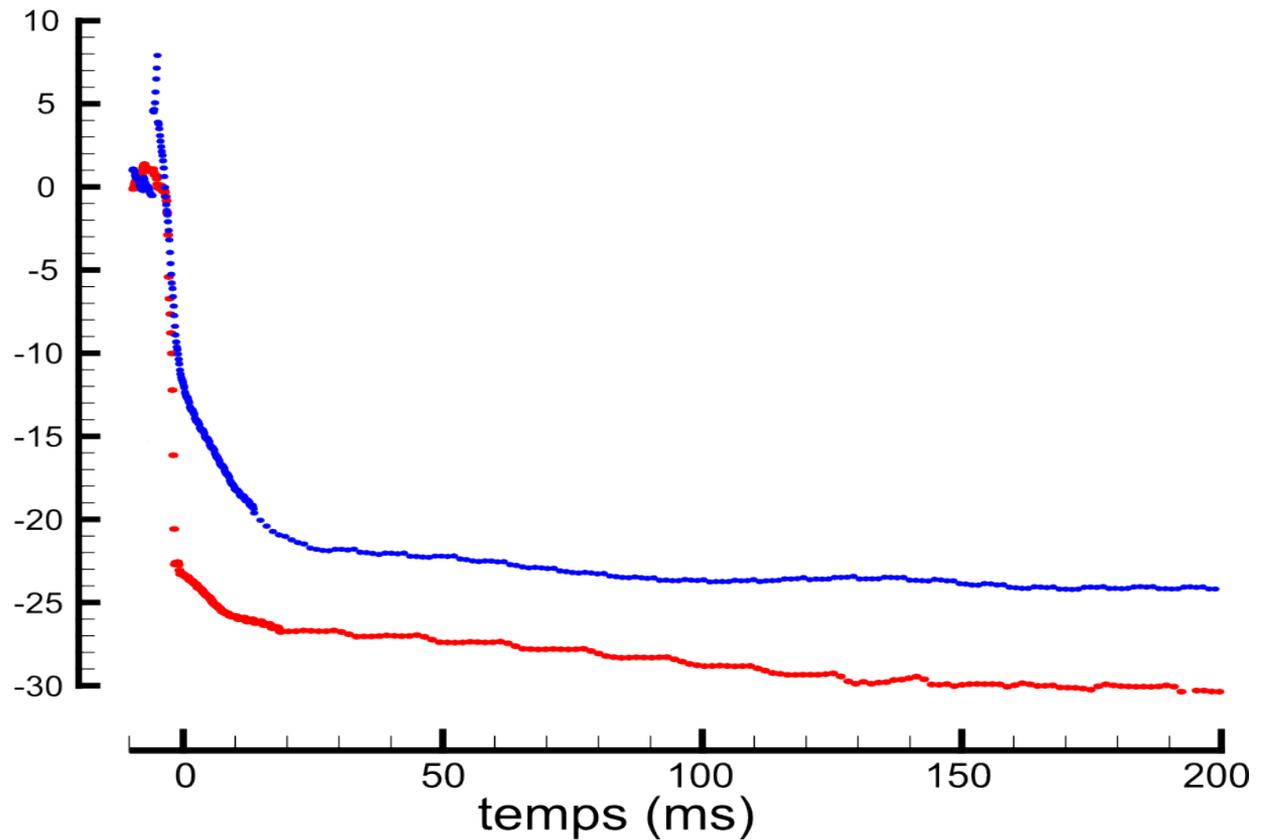
Protocole pour la destruction de microbulles avec augmentation de signal.

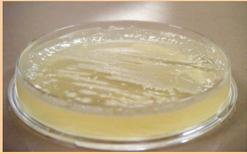


Protocole pour la destruction de microbulles avec augmentation de signal.

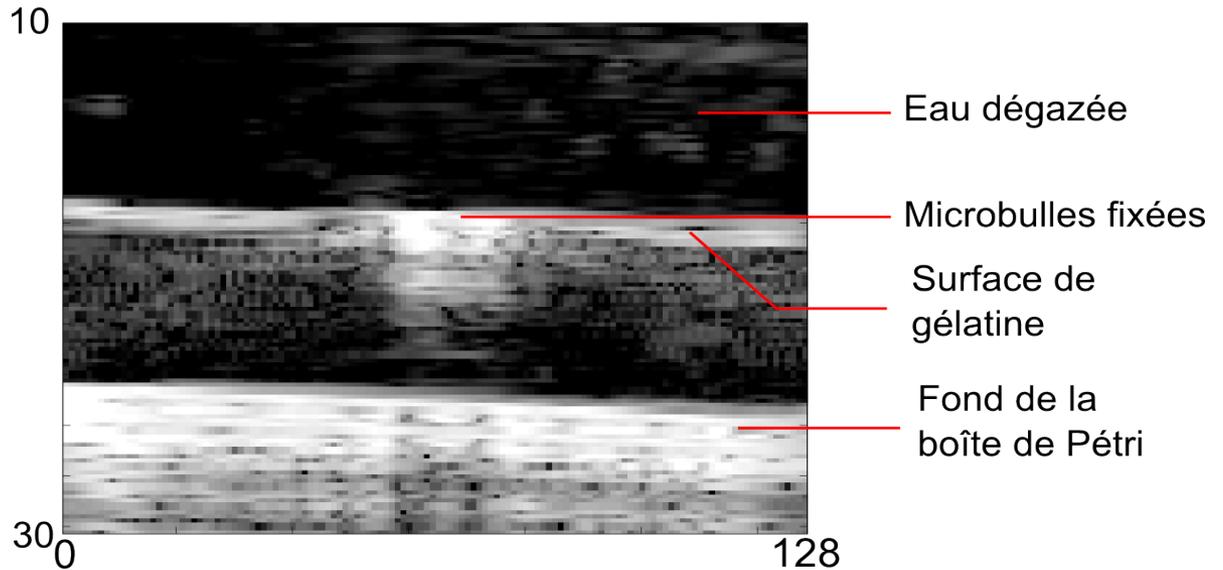
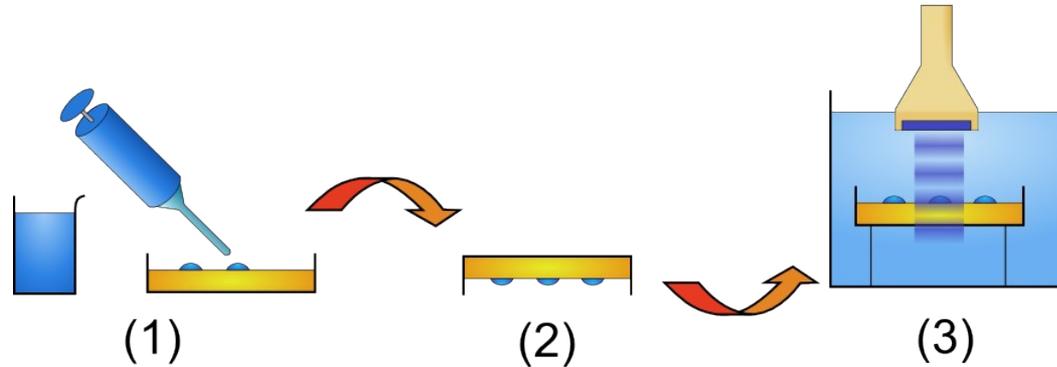
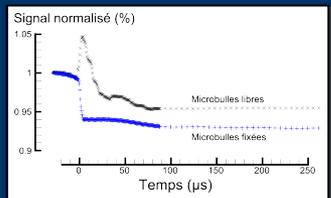
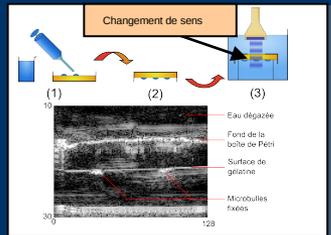
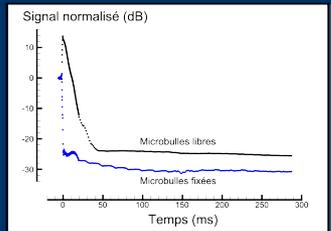
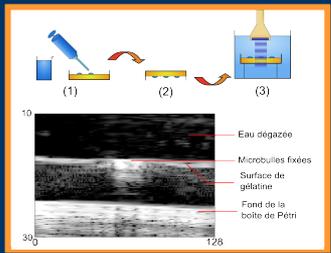


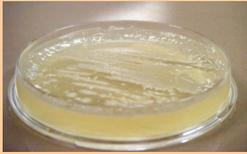
Signal normalisé (en dB)



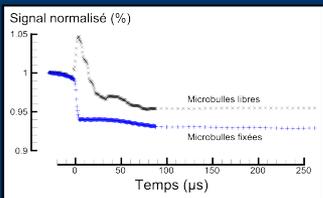
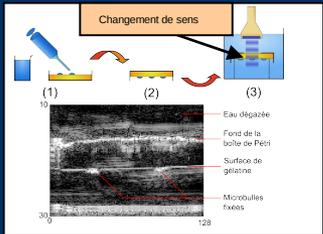
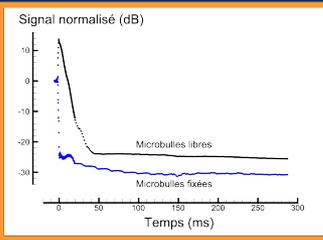
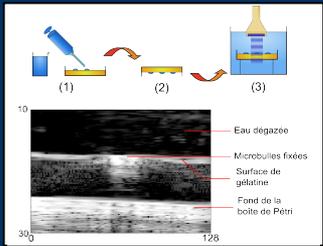


La différence entre bulles ciblées et non-ciblées est **confirmée**.

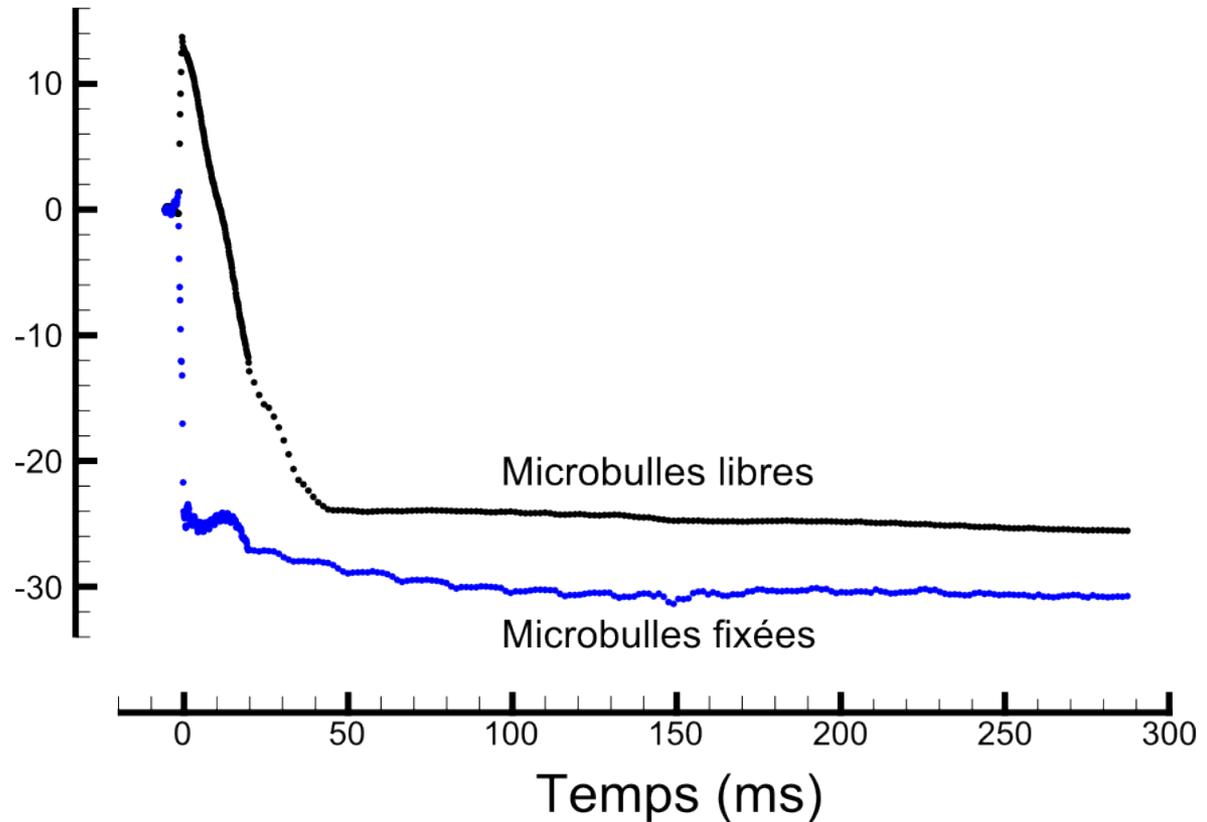


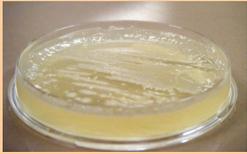


La différence entre bulles ciblées et non-ciblées est **confirmée**.

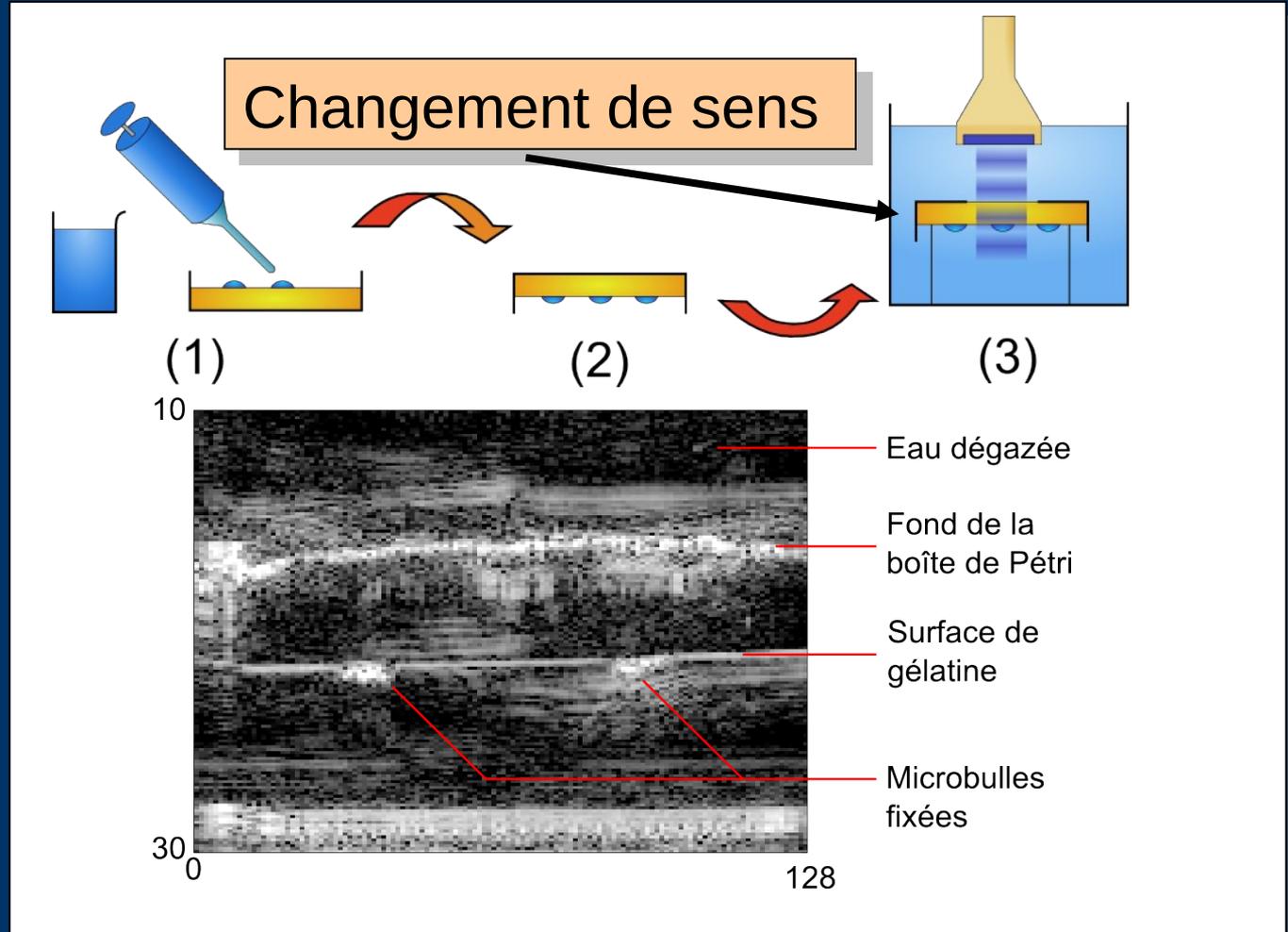
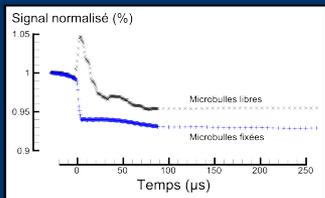
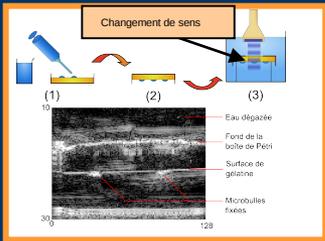
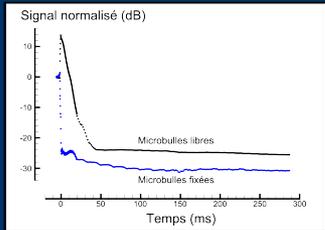
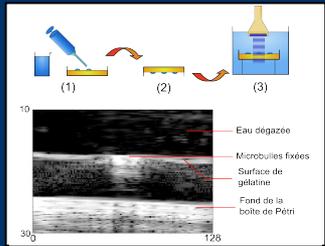


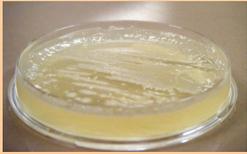
Signal normalisé (dB)



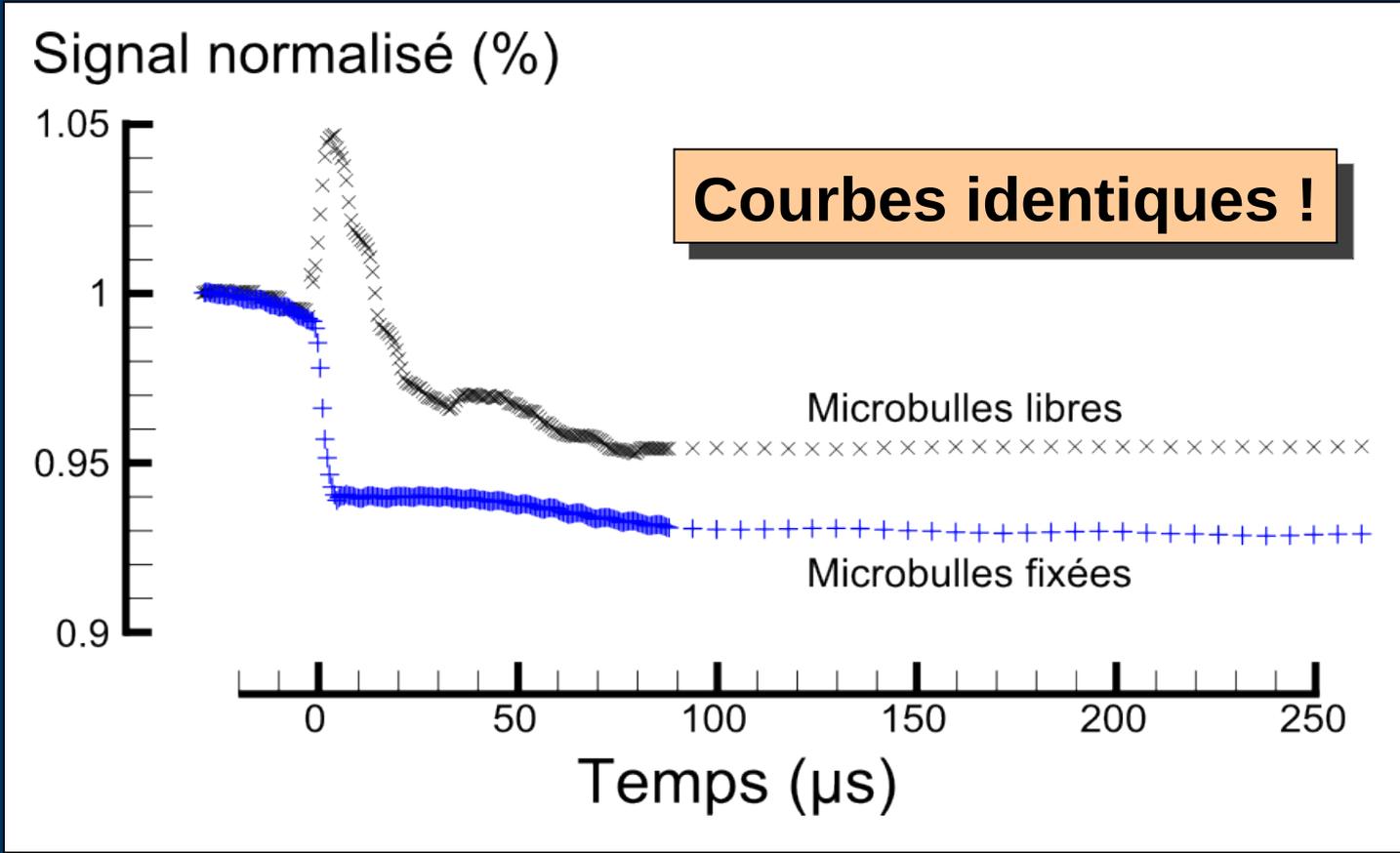
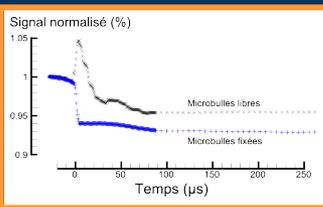
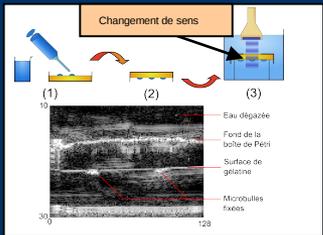
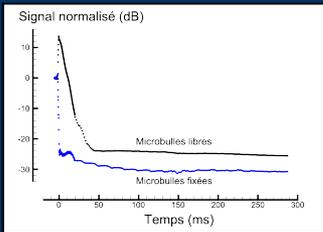
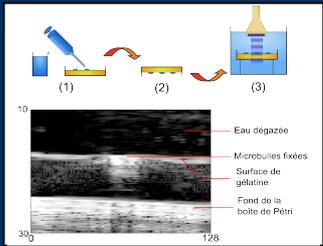


La différence est-elle due à une poussée des microbulles par les ultrasons dans les pores du gel ?

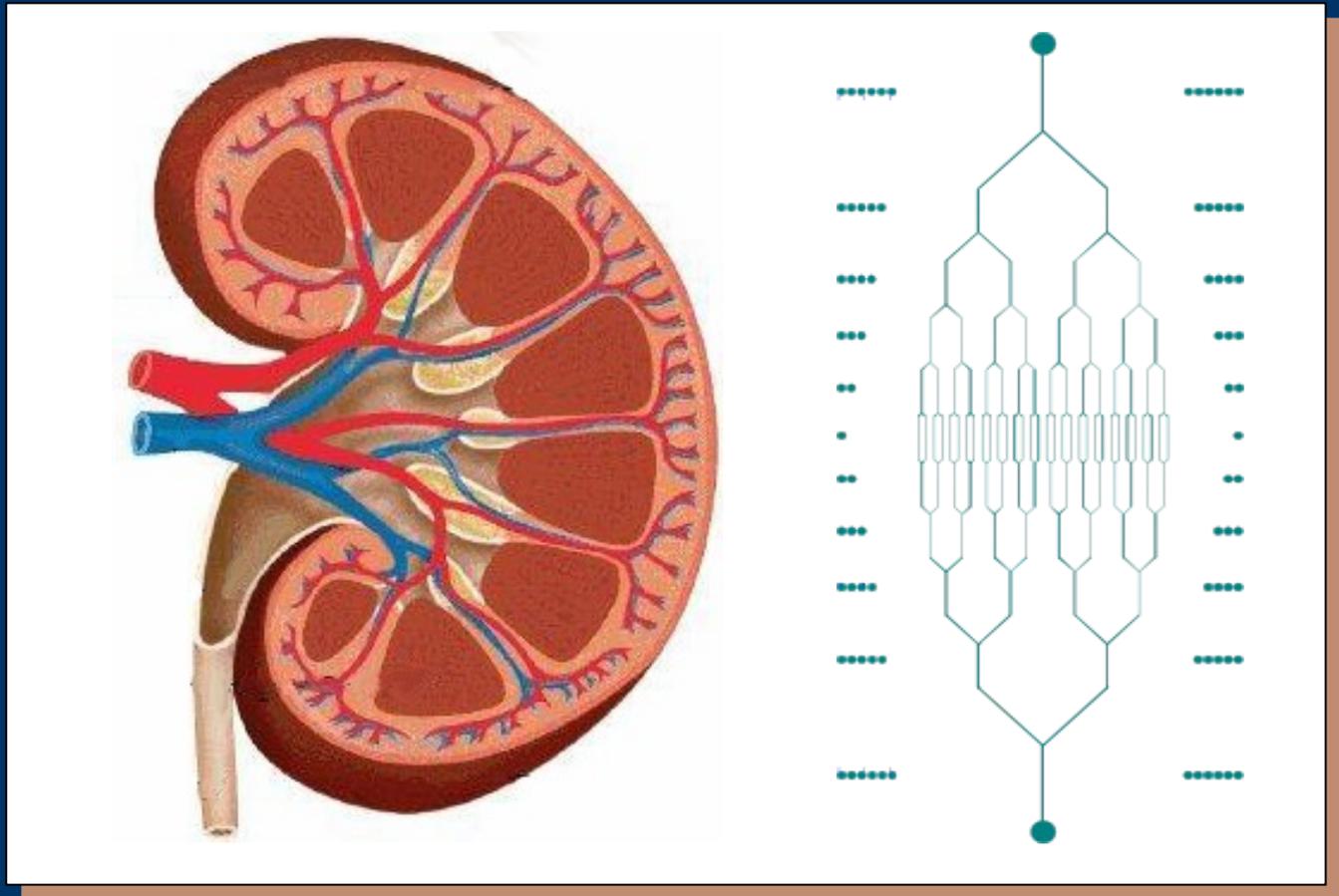
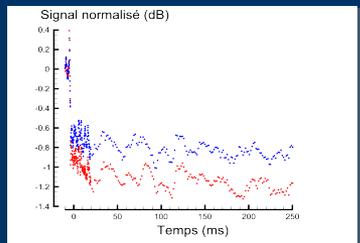
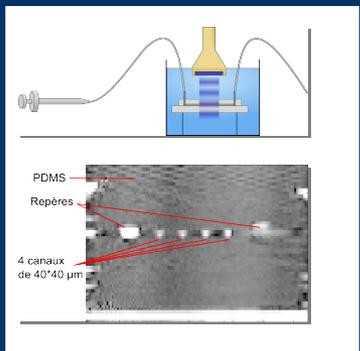
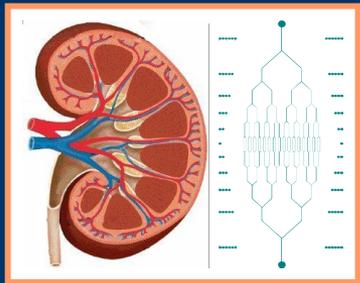
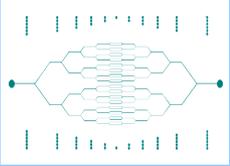




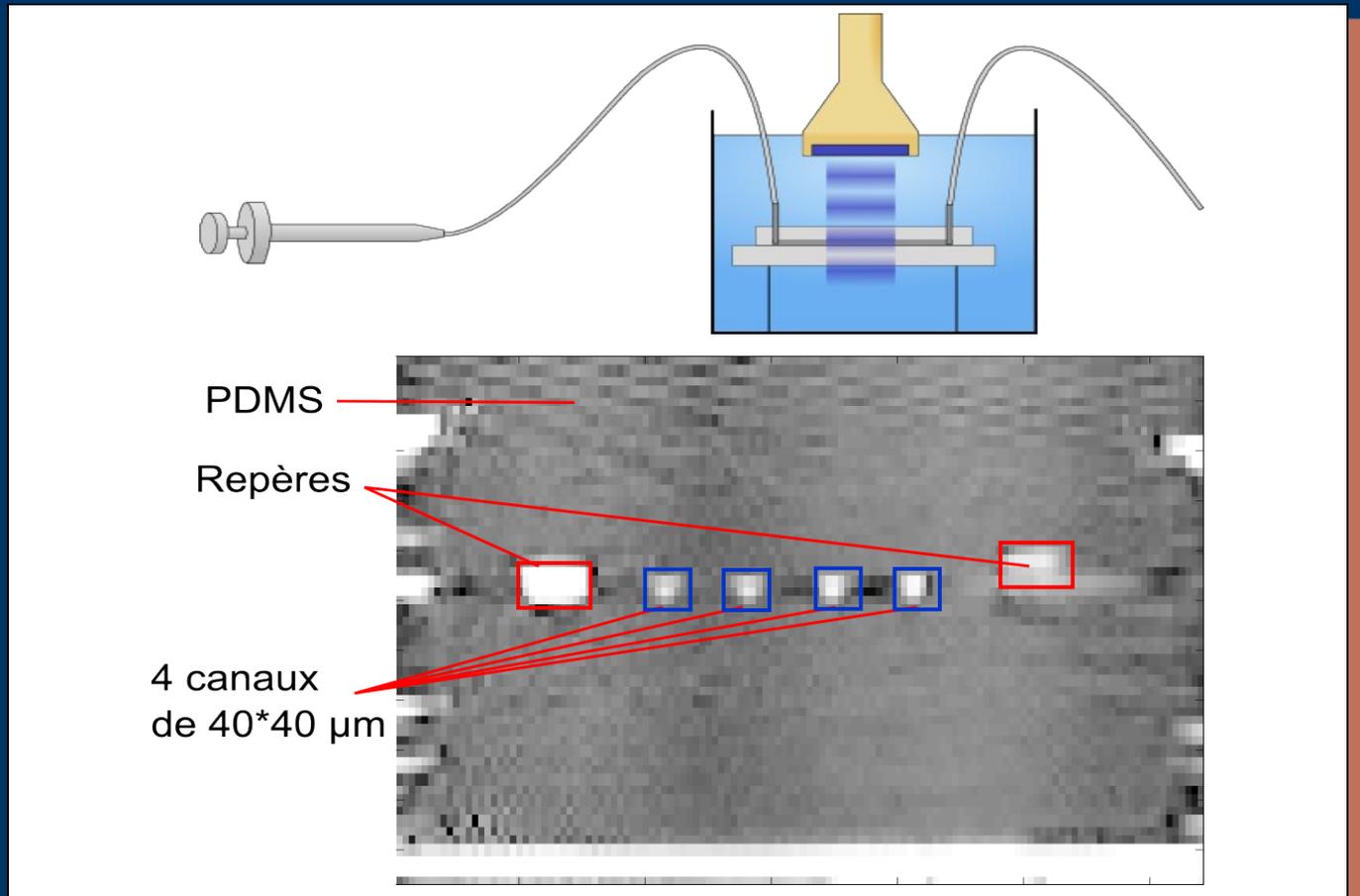
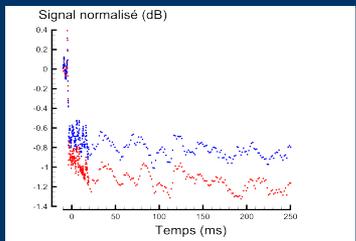
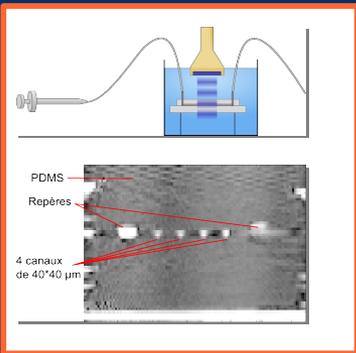
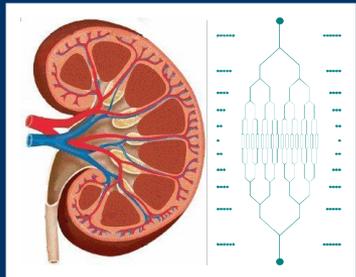
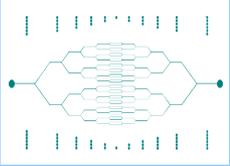
La différence est-elle due à une poussée des microbulles par les ultrasons dans les pores du gel ?

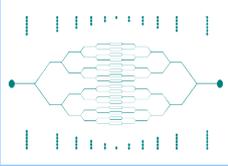


Les canaux microfluidiques peuvent servir de modèle vasculaire.

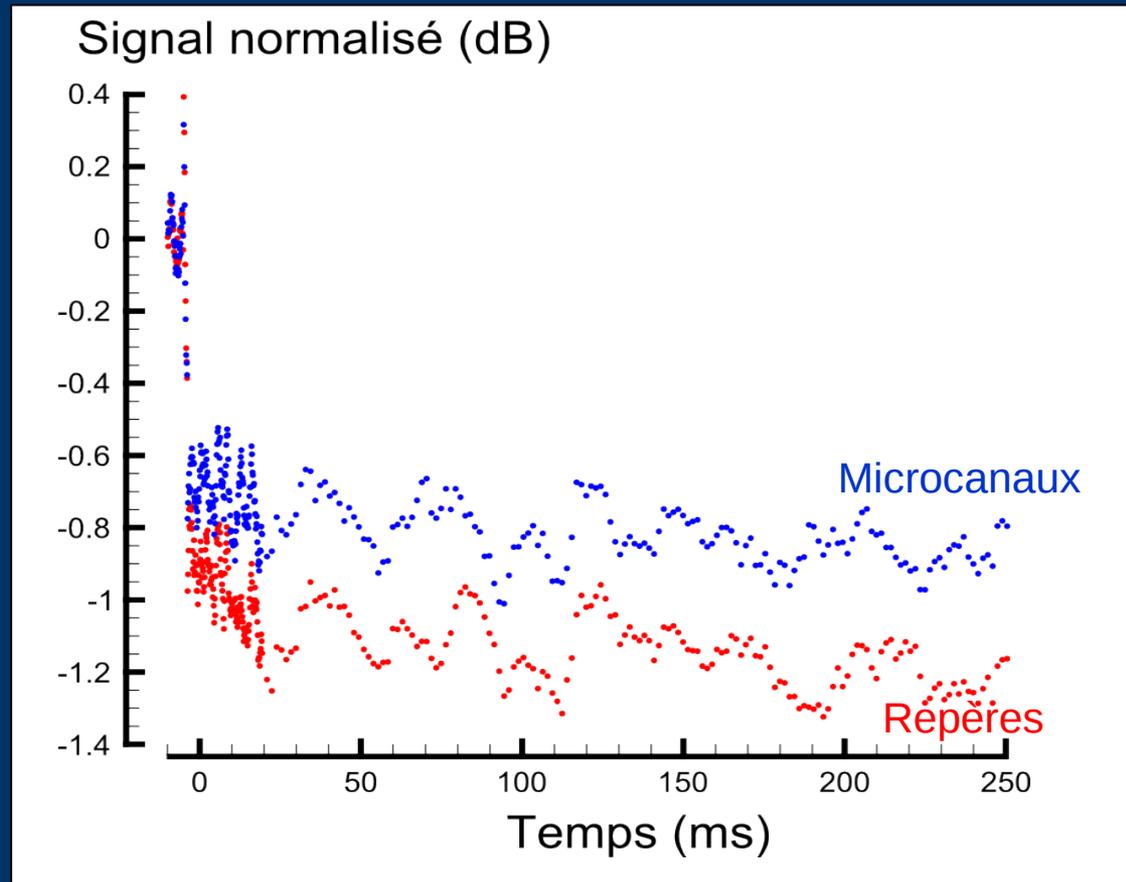
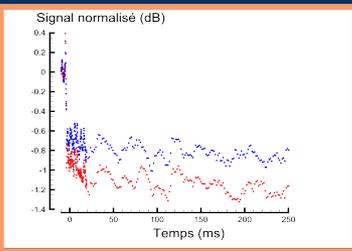
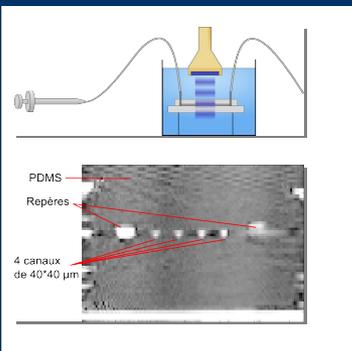
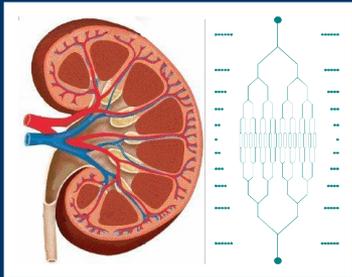


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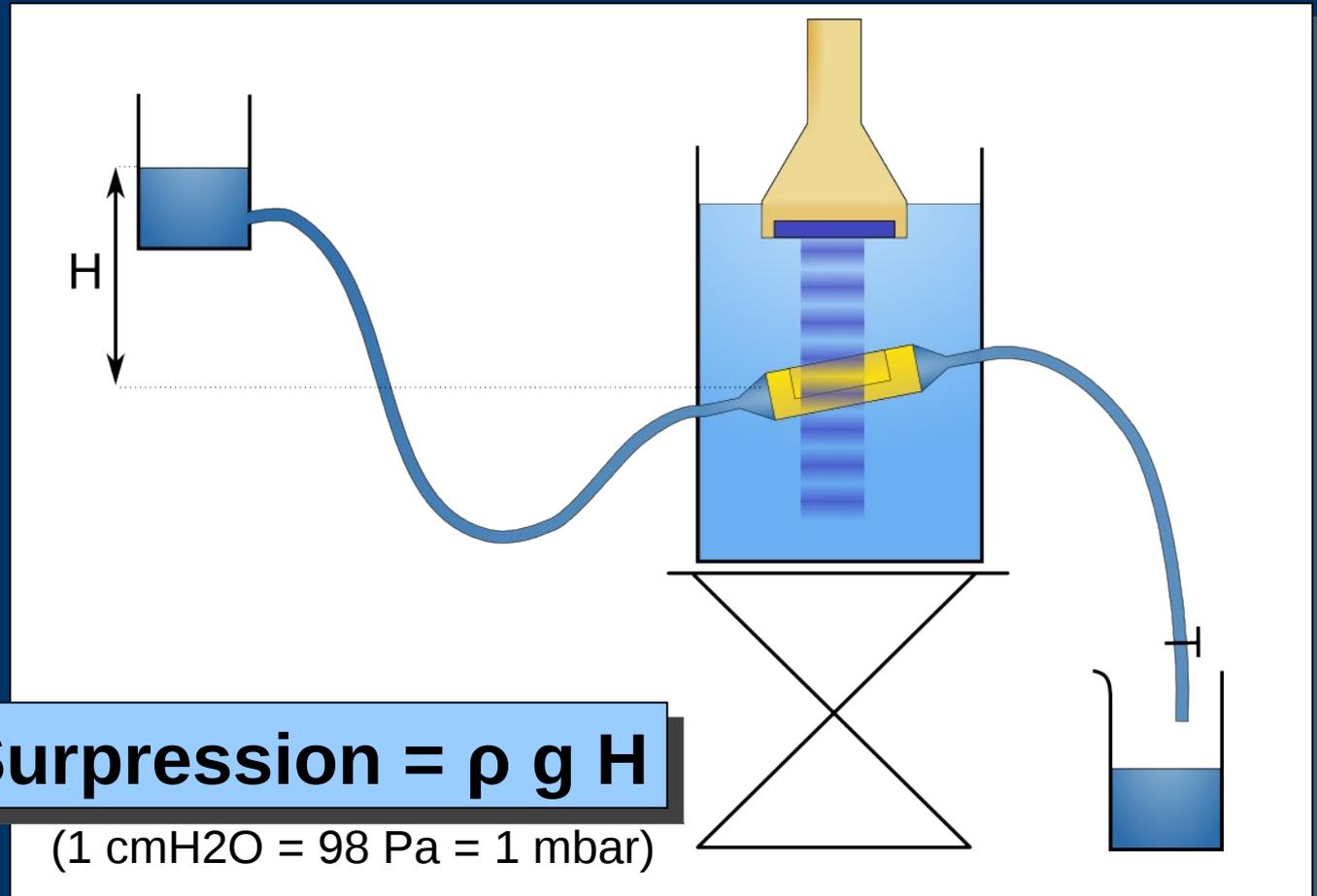
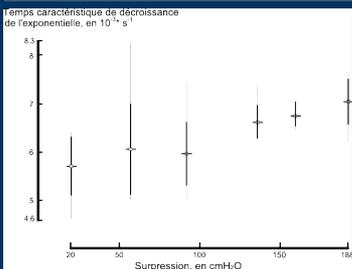
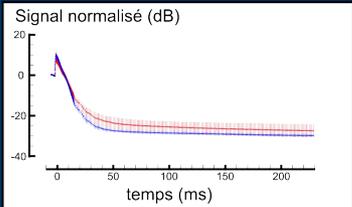
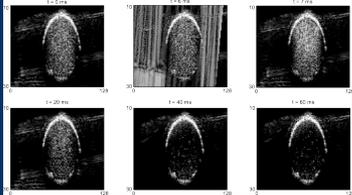
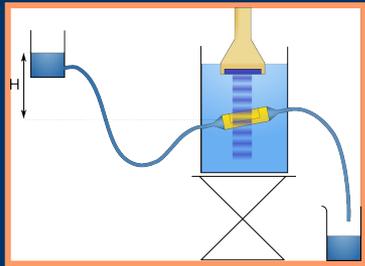


Les difficultés expérimentales sont importantes pour observer les dissolutions dans des microcanaux.





La dissolution des microbulles est mesurée à différentes pressions hydrostatiques.

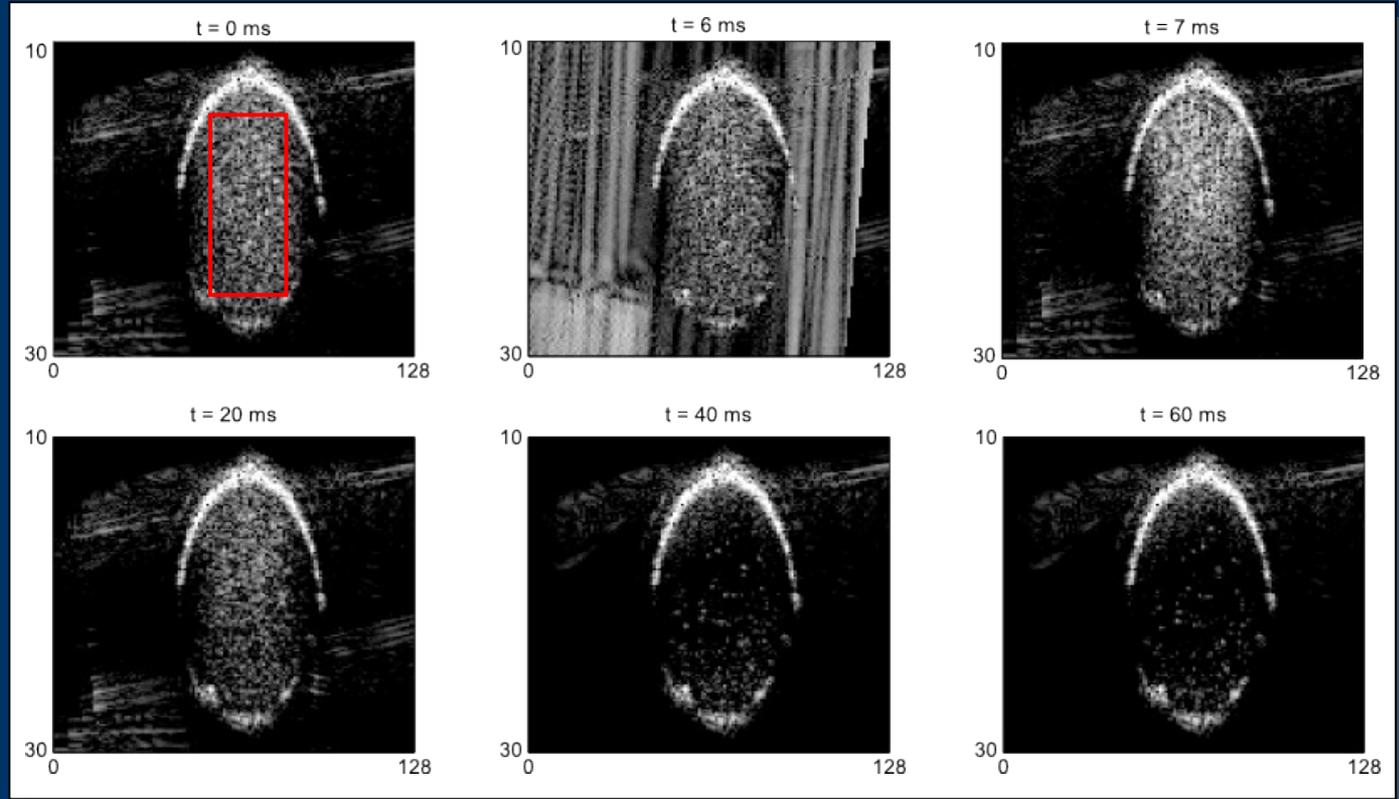
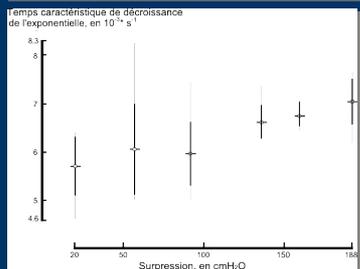
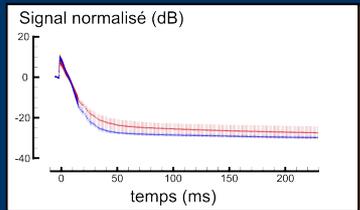
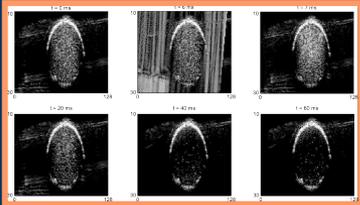
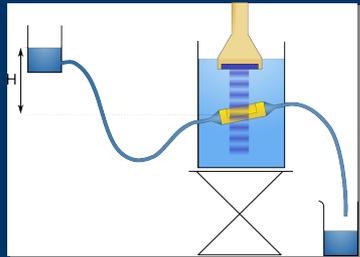


$$\text{Surpression} = \rho g H$$

(1 cmH₂O = 98 Pa = 1 mbar)

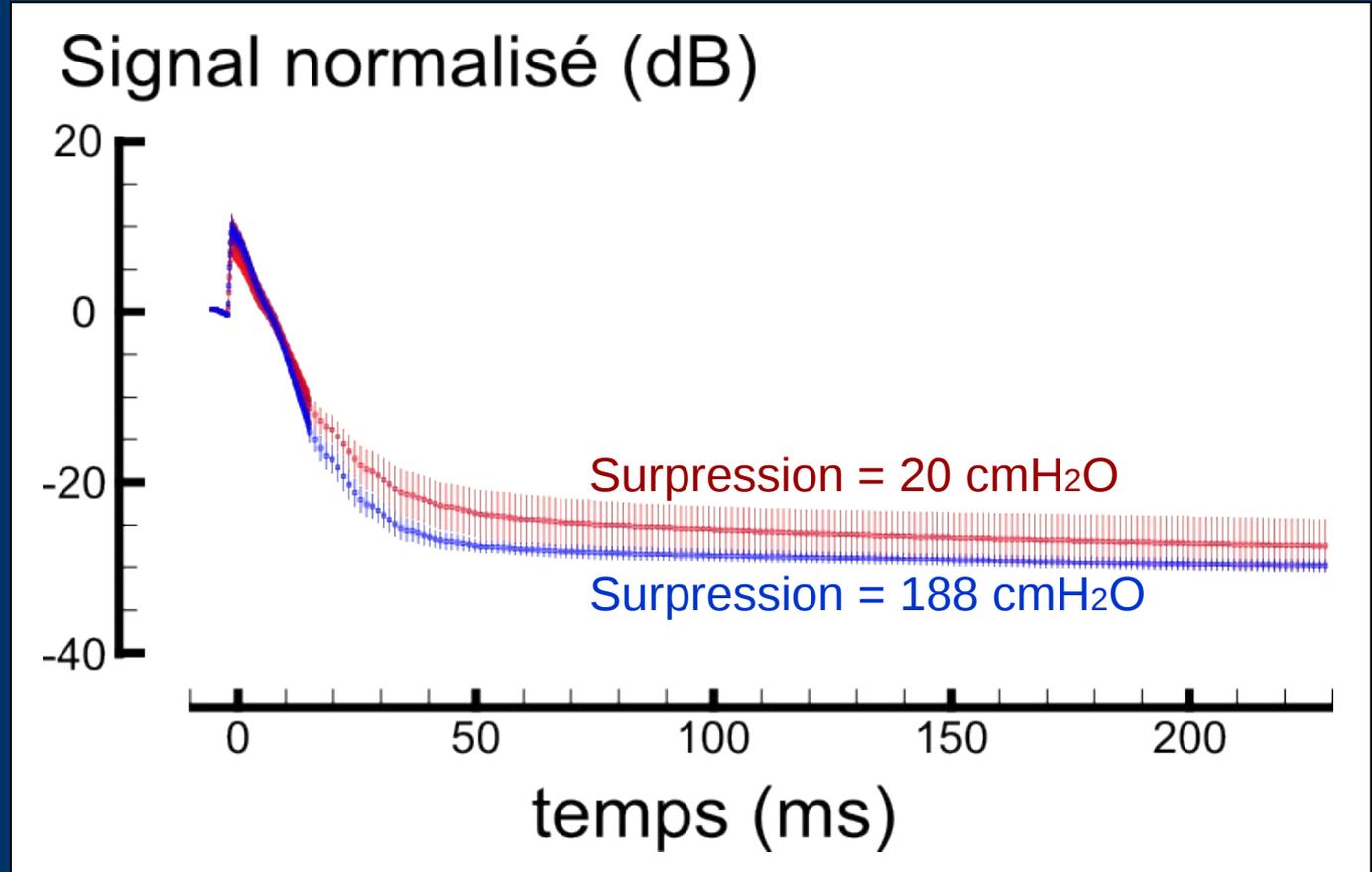
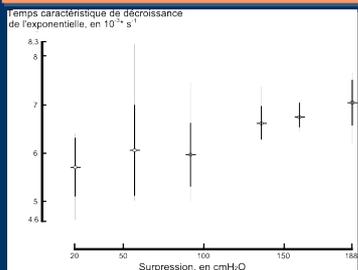
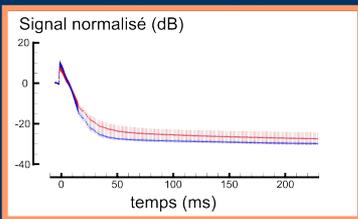
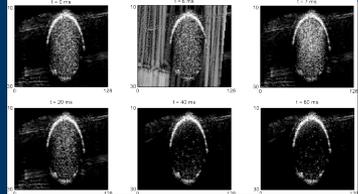
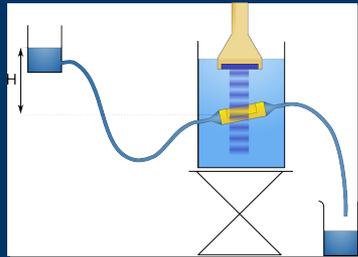


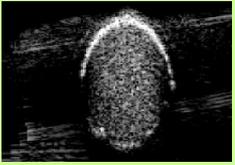
La dissolution des microbulles est mesurée à différentes pressions hydrostatiques.



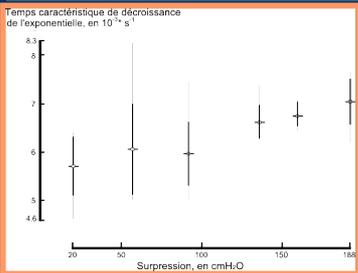
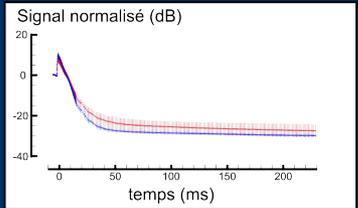
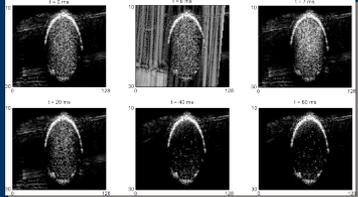
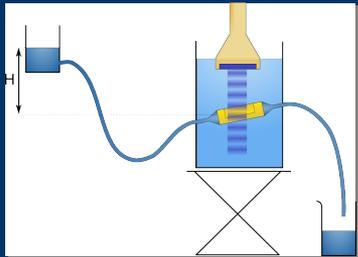


La dissolution des microbulles est mesurée à différentes pressions hydrostatiques.

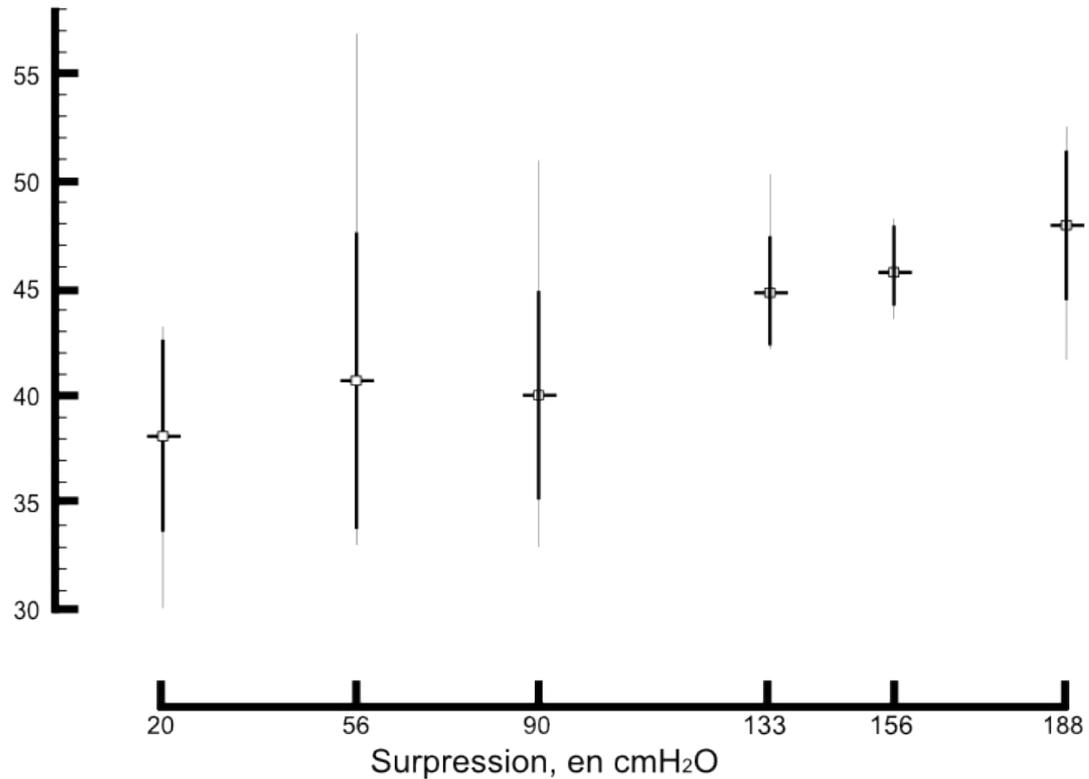




La vitesse de dissolution est dépendante de la pression.



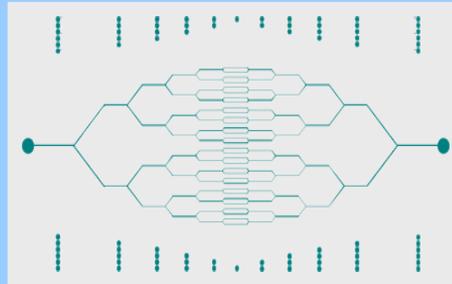
Temps caractéristique de décroissance de l'exponentielle, en $10^{-3} \cdot s^{-1}$



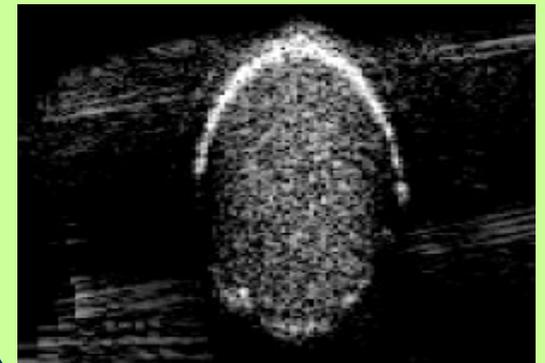
Ciblage des microbulles



Confinement dans des microcanaux



Influence de la pression



Merci pour votre attention

Des questions ?

