BME PARIS
BioMedical Engineering
MASTER'S PROGRAM

STICKING TO TISSUES: SLIPPERY WHEN WET

Open Your Mind Seminar

Friday, Oct 22 2021
1.30 pm – 3 pm

Arts et Métiers
155 Boulevard de l'Hôpital
75013 Paris
Pinel Amphitheater

Designing adhesive hydrogels for surgical applications

The fixation of hydrogels to soft biological tissues is of outmost interest for numbers of biomedical applications but it is a highly challenging task due to the fragile and wet nature of both hydrogels and tissues. Here, we explore how physical mechanisms occurring at hydrogel-tissue interfaces can be exploited to design bioadhesive hydrogels that are relevant for clinical applications. For that, ex vivo and in vivo experiments were devised to measure the adhesion between model polyethylene glycol hydrogel films and the surface of porcine livers. We find that a transition from a lubricated contact to an adhesive contact is governed by the transport of liquid across the tissue-hydrogel interface. This transition corresponds to a draining of the interface, which is well described by a simple model taking into account the microanatomy of tissues. Inspired by the pioneering works by Leibler and coworkers (Rose et al. Nature 2014), we also investigate how tissue-hydrogel adhesion can be created using particles that bridge the interface by adsorbing on both gels and tissues. We find that in the presence of blood, this particle bridging effect combined to the procoagulant properties of silica nanoparticles provide a way to enhance the adhesion strength by inducing the rapid formation of a clot at the interface. These results and methods shed a new light on the design of predictive adhesion tests and on the strategies to control the fixation of hydrogel based-implants.

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