

Research Topic for the ParisTech/CSC PhD Program

***Field (cf. List of fields below): 2**

Subfield: Surface chemistry and polymers

Title: Bio-inspired silicon surfaces for anti-biocontamination properties

ParisTech School: Ecole Polytechnique (LPMC), Palaiseau

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Short description of possible research topics for a PhD: Biocontamination is of great concern in a wide range of applications, including biomedical implants, food packaging, biosensors or industrial equipment. A reduction of these surface contaminations is pivotal, notably to prevent risks of infection or diseases for human beings. The objective of the thesis is specifically designed to treat and functionalize surfaces to eliminate pathogenic or unwanted biocontamination. Our first goal is to fully control the conception of reproducible green coatings consisting of the growth by ATRP (Atom Transfer Radical Polymerization) of polymer chains obtained from renewable resources (carbohydrates, essential oils or biomass extracts) onto model crystalline silicon substrates. These surfaces will allow an absolute quantification of the molar fraction of comonomers by FTIR spectroscopy in order to establish antibacterial activity criteria. Microbiologic tests will be performed by using pathogenic Gram-positive and Gram-negative bacteria. The second goal of this project is to transfer these grafting protocols developed on crystalline silicon onto various surfaces, like titanium, polymers, steel, for the design of new well-controlled surfaces adapted to the anti-biocontamination properties.

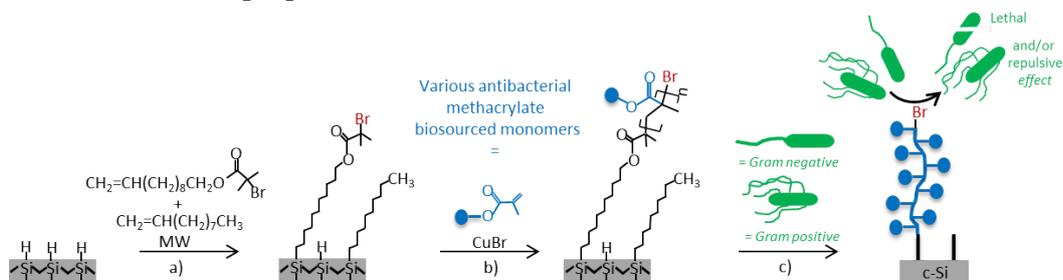


Figure. Silicon functionalization of bio-inspired polymers and antibacterial tests

Required background of the student: strong background in organic chemistry and material chemistry

A list of 5(max.) representative publications of the group: (Related to the research topic)

1. A. Faucheux et al., Well-defined carboxyl-terminated alkyl monolayers grafted on H-Si(111) : Packing density from a combined AFM and quantitative IR study. *Langmuir*, **2006**, 22, 153-162.
2. J. Yang et al., Quantitative assessment of the multivalent protein-carbohydrate interactions on silicon. *Analytical Chemistry*, **2014**, 86, 10340-10349.
3. S. Bedel et al., Antibacterial surfaces obtained from thymyl methacrylate polymerization. *Journal of Polymer Science Part A - Polymer Chemistry*, **2015**, 53, 1975-1985.
4. M. Maaz et al., Surface initiated supplemental activator and reducing agent atom transfer radical polymerization (SI-SARA-ATRP) of 4-vinylpyridine on poly(ethylene terephthalate). *Journal of Colloid and Interface Science*, **2017**, 500, 69-78.

