Research Topic for the ParisTech/CSC PhD Program

Field (cf. List of fields below): 1 - Chemistry, Physical Chemistry and Chemical Engineering

Subfield: Chemistry, Physical Chemistry, Materials Science

ParisTech School: Chimie ParisTech (Paris, France ; https://www.chimie-paristech.fr) / Institut Pierre-Gilles de Gennes (Paris, France ; http://www.institut-pgg.com)

Title: Functionalization of polymers by atmospheric pressure plasma in order to improve their adhesive properties

Advisor(s): Dr Cedric GUYON (cedric.guyon@chimieparistech.psl.eu) / Pr Michael TATOULIAN

Short description of possible research topics for a PhD: (

Most rubber compounds like EPDM and thermoplastic elastomers have very low surface energies. The low surface energy results in difficulty in bonding or coating materials onto these surfaces. Currently, the bonding process is long and complex to achieve adhesion specificities (abrasion, dip coating…). In fact, the incorporation of polar groups such as hydroxyls or amines groups is a preponderant factor for adhesion, thus promoting chemical anchoring. It is often demonstrated that the adhesion strength is linearly proportional to the density of plasma grafted groups on the surface of the material without altering the other physicochemical properties. Here we propose to optimize a plasma process at atmospheric pressure in order to be able to functionalize or realize a functional coating on the surfaces of the polymers studied in order to improve their adhesive properties. The polymer surface will be characterized by surface analysis techniques and the titration of functional groups will be realize.

Required background of the student:

Chemistry, Chemical Engineering, Material

Representative publications of the group: (Related to the research topic)

[1] Y. Ladner, F. d'Orlyé, C. Perréard, B. Da Silva, C. Guyon, M. Tatoulian, S. Griveau, F. Bedioui and A. Varenne, "Surface Functionalization by Plasma Treatment and Click Chemistry of a New Family of Fluorinated Polymeric Materials for Microfluidic Chips"; Plasma Process. Polym. (DOI: 10.1002/ppap.201300120) - April 2014.

[2] Da Silva, B., Schelcher, G., Winter, L., Guyon, C., Tabeling, P., Bonn, D. and Tatoulian, M. "Study of the stability and hydrophilicity of plasma-modified microfluidic materials", Plasma Processes and Polymers , 4 OCT 2016, DOI: 10.1002/ppap.201600034.

[3] High density gold nanoparticles immobilized on surface via plasma deposited APTES film for decomposing organic compounds in microchannels ,Xi Rao, Cédric Guyon, Stephanie Ognier, Bradley Da Silva, Chenglin Chu, Michaël Tatoulian, Ali Abou Hassan, Applied Surface Science Volume 439, 1 May 2018, Pages 272-281