

Title: Oscillatory chemical reactions in advanced materials for healthcare applications

Abstract:

Polymeric oscillators under lab conditions are a new concept primarily associated with only two research groups worldwide, Professor Ryo Yoshida's research group, Tokyo University and the Novakovic research group, Newcastle University. The ultimate aim in linking oscillatory chemical systems with polymer science is the development of useful materials and devices that otherwise would not be feasible. The vision includes fully self-oscillatory materials, materials that act life-like, materials that are able to carry and dispense their content in predefined rhythms, and materials which can generate environment which favours cell self-assembly into functional tissue, e.g., healing of a heart tissue following myocardial infarction. The talk will showcase progress in this area so far and present most recent developments in Novakovic lab ranging from first ever mono- and poly-functional polymeric substrate oscillatory chemical reactions (employing alkyne-terminated poly(ethylene glycol)) to recently expanded family of polymeric catalysts successfully applied to oscillatory systems (using polymer-bound palladium catalysts). Moving to all polymeric oscillatory systems and further to oscillatory materials enables containment of the active chemical species within the scaffold, crucial to reduced toxicity and biocompatibility of these systems.

Bio:

Dr Katarina Novakovic, Senior Lecturer in Chemical Engineering, at the School of Engineering, Newcastle University, UK, is a leading expert in Oscillatory Carbonylation Reactions (OCRs) with a core interest in their applications to intelligent materials for novel healthcare technologies and other interdisciplinary uses. Katarina graduated from the University of Belgrade, Serbia (1997) with a degree in Chemical Engineering, specialising in Organic Chemical Technology and Polymer Engineering. Following, she worked in the pharmaceutical industry (1997-2000) at Solid Forms Plant, Hemofarm. Katarina obtained her PhD (2000-2004) from the School of Chemical Engineering and Advanced Materials, Newcastle University, where she gained expertise in the area of mathematical modelling and simulation of polymerisation processes in a Spinning Disc Reactor. Subsequently, Katarina continued working at Newcastle University and began to study the oxidative carbonylation reaction and achieved reproducible oscillations in both pH and heat output. Katarina's efforts in this area resulted in a five year EPSRC Career Acceleration Fellowship awarded in 2009 (CAF2009). Building on the outcomes from CAF2009, in 2012 Katarina was awarded further funding via the EPSRC Developing Leaders award. At that time Katarina entered the area of stimuli responsive hydrogels, her research group now pursues as injectable, implantable, and transdermal forms. EPSRC support enabled Katarina to establish new directions in the area of intelligent polymeric materials and discover the world's first oscillatory chemical reaction employing a polymeric substrate. These findings accelerated to further developments and EPSRC Healthcare Technologies Impact Fellowship (2016) where Novakovic group achieved a proof-of-principle rhythmic material envisioned for application in hands-free drug delivery and mechanoresponsive tissue regeneration. Recent studies expanded a range of materials studied to include investigations of bioglass-hydrogel scaffolds for tissue regeneration and hydrogel based materials for immunomodulatory applications.