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Chemistry Department

Theranostic particles for pulmonary delivery

Group of Polymer Synthesis & Processing (GPS&P)
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REQUIMTE, Faculdade de Ciências e Tecnologia
Universidade NOVA de Lisboa

Ana Aguiar-Ricardo

Principal Investigator

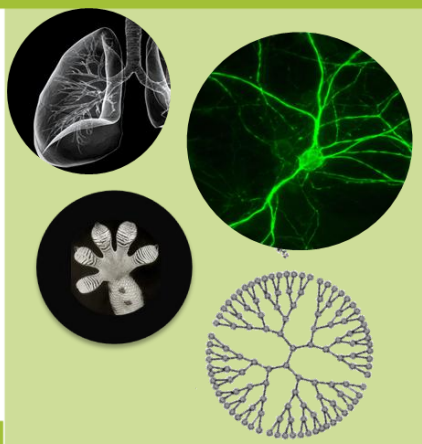
Co-author of over 63 peer reviewed papers. PhD in Chemistry, at UNL(1994), post-doctoral work at Univ. of Nottingham, UK(1995), visiting position at MIT, USA, (July-Dec 2007). In 2011, she was appointed with the Habilitation in Sustainable Chemistry.

Objectives

Conferring to World Health Statistics [1], lung diseases is an area of great concern, in particular, lung cancer is responsible for 23% of total cancer deaths; the cancer survival tends to be poorer due to an often advanced stage at diagnosis.

This project proposes the development of novel dry powder formulations for pulmonary delivery.

Sustainable methodologies mastered by the team will be applied to prepare the aerosolizable microparticles assembling the multifunctional nanocomponents integrating active therapeutic and imaging agents [2].



Methodology

Aerodynamic microparticles are prepared by supercritical assisted atomization (SAA). In this process, supercritical carbon dioxide is mixed, in a static mixer, with the liquid solution containing the polymer and the multifunctional nanovehicles. The multicomponent mixture is then sprayed through a nozzle forming multifunctional microparticles collected in the cyclone.

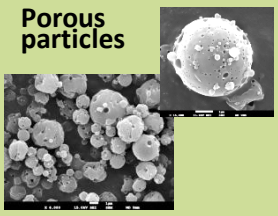
The nanovehicles are synthesized in $scCO_2$ and engineered to conjugate with specific active ingredients (e.g. drugs, biomolecules, receptors). As the nanovehicles have a hydrophilic outer shell and a hydrophobic central core can upload either hydrophilic or hydrophobic active compounds.

SAA apparatus at NOVA

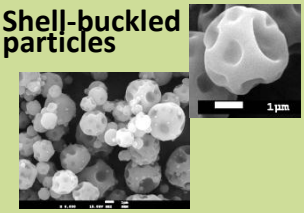
Expected Results

- The assembled polymeric microparticles loaded with specific therapeutics will aerosolize into the lungs using dry powder inhalers (DPIs).
- The co-assembly with nanovehicles, conjugated with tumor-specific docking moieties (e.g. anti-epidermal growth factor receptor antibody, tumor necrosis factor), will enable these new formulations to be used in cancer theragnosis.
- The new nanomedicine formulations could be designed also to treat other lung diseases as chronic pulmonary infections, cystic fibrosis or asthma.

Porous particles



Shell-buckled particles



[1] A. Jemal, F. Bray, M.M. Center, J. Ferlay, E. Ward, D. Forman, Global cancer statistics. *CA-Cancer J. Clin.* 2011, 61, 69. World Health Statistics, World Health Organization France 2010, 2010, pp. 1-177; [2] R. B. Restani, P. I. Morgado, M. P. Ribeiro, I. J. Correia, A. Aguiar-Ricardo, V. D. B. Bonifácio, *Angew. Chem. Int. Ed.*2012, 51, 62.

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