From Serum to Cells: Revealing the Identity of the Protein Corona Adsorbed on Porous Silica Nanoparticles

Alden M. Clemments[a], Carlos Muniesa[b], Pablo Botella[b], and Christopher C. Landry[a]

[a] Department of Chemistry, University of Vermont
82 University Place, Burlington, VT 05405, USA

[b] Instituto de Tecnología Química, UPV-CSIC,Campus de la Universidad Politécnica de Valencia, Avenida de los Naranjos s/n, 46022 Valencia, Spain

The emergence of nanotechnology has provided novel platforms for treating an array of diseases. Where traditional therapies lack specificity, engineered nanoparticles offer the ability to selectively target certain tissues and cells. However, a thorough understanding of the nanomaterial-biological interface remains inconclusive. While it is known that upon exposure to biological fluid, proteins and other biomolecules readily adsorb to the nanoparticle surface, less is known about how the formation of this 'protein corona' determines the material's biological fate. Thus, in order to turn these novel platforms into actual therapies, a more thorough understanding of these fundamental interactions is required.

Of these novel platforms, porous silica nanoparticles have been of particular interest due to their high internal surface area, ease of construction, and biocompatibility. Properties such as nanoparticle shape, composition, and surface chemistry have all been shown to greatly influence the formation of this protein coat. However, many of these studies have been limited to nanoparticles smaller than 200 nm. Additionally, quantification of the protein corona has remained unresolved. Thus, utilizing mass spectrometry and thermogravimetric analysis, we have been able to demonstrate that not only can the identity of the protein fingerprint be resolved, but the relative quantities of each protein can also be determined. By modifying the nanoparticle surface with various chemical functionalities, we demonstrated that protein accumulation at the surface was highly influenced by the chemical nature of the nanoparticles. Additional studies have indicated that nanoparticle diameter influences the degree of protein accumulation. Finally, current studies investigating the evolution of the protein corona after cellular internalization are being conducted.