Chemistry at the silica interface: from fundamentals to applications

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The presence of silica in biomineralized structures of organisms from single celled diatoms through higher plants and primitive animals such as sponges is relatively well known. In addition, although the microscopic and macroscopic structures can be observed in some detail, the chemical and biochemical processes giving rise to such fantastically well-organized structures is incompletely understood. What is even less well understood is the effect(s) that silica and its constituent components can have on the biochemical processes of other cells.

My research group is currently involved in fundamental studies of biomolecule mineral interactions as well as development of tools to probe such interactions and are applying this knowledge to the development of materials with potential for application in the biomedical field. The majority of our studies are experimental in nature complemented by more limited theoretical/ computational approaches though we are seeing the latter approaches become more firmly embedded in our studies through collaboration.

In this contribution I will describe

(1) how the surface chemistry of silica moderates interaction with biomolecules such as small peptides, including development of spectroscopy techniques to assess interactions,

(2) the effect of 'silica' as a component of silk-silica composites on the upregulation of biochemical markers associated with bone regeneration,

(3) how silica materials can be used as tissue culture surfaces for use in the study of cancer.

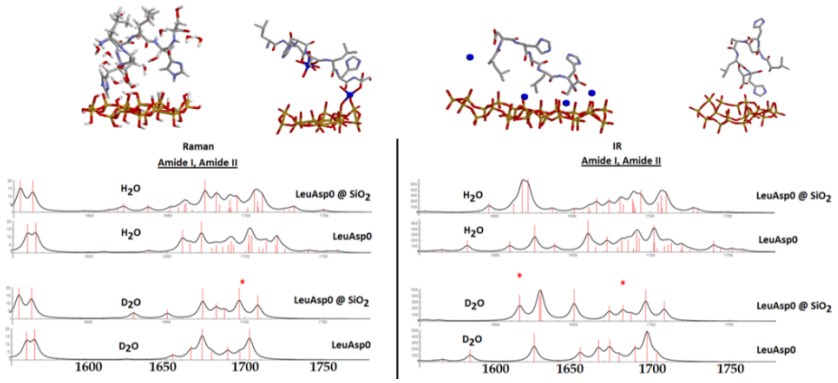

Figure 1: an example of the data we are accumulating combining computational analysis and spectroscopy.