VIDEO ARTICLE

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On the Formation and Study of Multifunctional Nanoprobes using Chemical Methods

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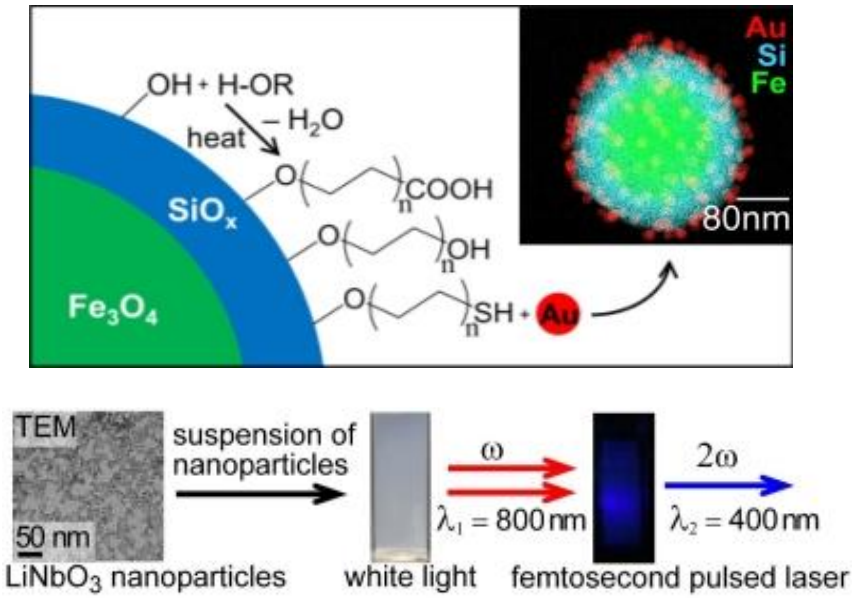
Graphical Abstract



Abstract

Nanoprobes. Nanomaterials are attractive for their small size and for the ability to tune their composition and, therefore, their properties. These materials are enabling many new studies at the interface between disciplines. Attractive properties include tuning their electronic structure, defects, and magnetic properties to enable new forms of nanoprobes. Nanoprobes have been created, for example, with high brightness and stable fluorescent properties for use in probing biological systems. A relatively new form of nanoprobe rely on non-linear optical phenomena such as second harmonic generation (SHG) to enable study over long timescales and to depths previously not possible with fluorescent probes. Realizing the potential for these SHG nanoprobes requires fine control over composition, size, and properties. We have demonstrated the ability to prepare single-crystalline SHG nanoprobes with tuned dimensions using synthetic techniques aimed at scale-up processes [**1**-**3**]. Another key aspect to using these nanoprobes is to adjust their surface chemistry to stabilize their composition, maintain a colloidal state, and enable use as probes in multiple systems. We have applied a relatively new approach to tuning the chemical functionality at the surfaces of nanoprobes, which

utilizes widely available reagents and can be readily extended to other laboratories [**4**]. We will demonstrate how this method can add a range of functional groups to nanoprobes and to couple biologically relevant molecules to these nanoprobes while preserving their SHG properties. We will highlight progress towards developing both SHG and magnetic nanoprobes and tuning their properties, as well as prospects for further development in this field.

Keywords: Nanomaterials, surface chemistry, functional materials, nanoprobes.

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Biography of Presenting Author

Byron D. Gates is a Professor of Chemistry at Simon Fraser University. He pursues research in the synthesis, surface modification, and self-assembly of nanomaterials. His work includes remotely triggered molecular release from nanomaterials, preparation of custom optical materials, enhanced molecular sensing through materials design, improved electrocatalysts through the design of materials in search of structure-to-function correlations, and fundamental studies in self-assembly of nanomaterials. He was a co-founder of 4D LABS, an $80M materials research institute at SFU, and served as Head of the Centre for Soft Materials where he built advanced electron microscopy and fuel cell testing facilities. He has published >135 peer-reviewed papers and 6 industry reports. He was a Canada Research Chair (CRC) in Surface Chemistry (2005-2014), and recipient of an SFU Faculty of Science Excellence in Teaching Award. He supervises a diverse research team, who also engage collaborators from around the world. He has hosted trainees from 21 countries and has supervised 35 graduate students, 14 postdoctoral fellows, and >100 undergraduate researchers through directed studies projects. Further details of Dr. Gates, his research team, and their achievements can be found here: http://www.sfu.ca/chemistry/gates/

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