Biofunctionalization for Enhanced Photoluminescence of Nanopatterned Silica from the Diatom *Cyclotella sp.*

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The conjugation of proteins, peptides, and other biomolecules to silica substrates, a process called biofunctionalization, is an emerging area of bionanotechnology that has an array of applications ranging from drug delivery systems to biosensors. Biogenic silica microstructures called "frustules" that are derived from the shells of single-celled algae called diatoms are a particularly attractive substrate for these applications, because the frustule surface is intricately patterned at the nano-to-microscale, and is populated with reactive silanol (SiOH) groups. Prior to biofunctionalization, silanol groups on the surface of the biosilica frustules isolated from the centric diatom *Cyclotella sp*. were covalently functionalized with 3-aminopropyltrimethoxysilane. The amine functionalized silica frustules were then covalently coupled to the antibody Rabbit Immunoglobulin G (IgG), which selectively binds to its complimentary antigen, Goat anti-Rabbit IgG. Binding was validated by fluorescent labeled antigen, which allowed for direct observation of microscale patterning of the antibody on the frustule by epi-fluorescence microscopy. The antibody functionalized diatom frustule was then tested for its ability to serve as a selective biosensor for its complimentary antigen using photoluminescence (PL) spectroscopy. The antibody functionalized diatom biosilica had an intrinsic PL signal six times that of bare diatom biosilica. Furthermore, when the antibody functionalized diatom frustule was covalently bound to its complimentary antigen the PL signal increased by another factor of two. These results suggest that antibody functionalized diatom biosilica has the potential to serve as a selective biosensor platform for the label-free detection of target antigens using nano-enabled PL.