Synthesis of Universal Ligands for Metal Oxide Surfaces: Controlling Surface Functionality through Click Chemistry

"Lead Inventors: Meghann A. White; Jeffery T. Koberstein, Ph.D.; Nicholas J. Turro, Ph.D.

Metal Oxide Nanoparticles Require Surface Ligands Stabilization for Increased Functionality Metal oxide nanoparticles have recently attracted attention for their potential uses in various applications. In many practical applications, nanoparticle cores must be stabilized with surface ligands which both prevent aggregation and also provide a handle that conveniently allows functionalization of the final periphery of the system. A common approach involves ligand exchange - stripping off nonfunctional ligands used for synthesis and then redispersing the particles with functionalized ligands. However, due to the difficulties of dispersing metal oxide nanoparticles in various solvents without aggregation, it is of significance to explore a ligand system that can not only dictate nanoparticle dispersibility but also allow for further functionalization.

Synthesis of Surface Functionalized Metal Oxide Nanoparticles through Design of Versatile Ligands This technology demonstrates a strategy for the synthesis of surface functionalized metal oxide nanoparticles through the design of versatile ligands. Such ligands include an anchoring portion that bind to a variety of metal oxide surfaces and a functional portion that can be attached to other objects (e.g., atoms, molecules, proteins, viruses, polymers, etc.) Click chemistry is employed to irreversibly link the target of choice. These universal ligands, which possess the flexibility and synthetic generality, allow the construction of a broad range of functionalities for the periphery of nanoparticles with good yields and synthetic facility.

Applications:
• Cosmetic applications
• Paint applications
• Thin films with homogenous nanoparticle dispersions that allow more consistent electronic device performance
• High dielectric constant materials compatible with electronic device manufacturing requirements
• Nanocomposites for improved mechanical properties
• Targets for magnetic drug delivery and time-release drug
• Cellular delivery carriers
• Magnetic Resonance Imaging (MRI) contrasting markers

Advantages:
• Flexibility and synthetic generality
• Functional group orthogonality
• Applicable to other metal oxide surfaces (nanoparticle or bulk)
• Good yields, no byproducts
• Wide range of applications

Licensing Status: Available for Licensing and Sponsored Research Support

Meghann A. White, Ashok Maliakal, Nicholas J. Turro, Jeff Koberstein, ““Click”” Dielectrics: Use of 1,3-Dipolar Cycloadditions to Generate Diverse Core-Shell Nanoparticle Structures with Applications to Flexible Electronics, *Macromolecular Rapid Communications*, 2008, Volume 29 Issue 18, Pages 1544-1548
Meghann Brown, Jeremiah Johnson, Nicholas J. Turro and Jeffrey T. Koberstein, Using Click Chemistry to Functionalize the Surface of Iron Oxide Nanocrystals, *MRS meeting SESSION W11.16, Poster Session: Colloid II, Apr 20, 2006*

**Inventors**

Jeffrey Thomas Koberstein