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Applying Sustainable Design Principles to Emerging Nanomaterials: The Center for Sustainable Nanotechnology

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Abstract: As nanotechnology moves toward full-scale commercialization, understanding and controlling the environmental impact of high-volume manufactured nanomaterials and their chemical transformation products becomes increasingly important. Designing and synthesizing chemically and structurally heterogeneous nanomaterials from earth-abundant and non-toxic elements would reduce both the manufacturing cost and environmental impact of nano-enabled technologies. Controlling the physicochemical properties of nanomaterials to achieve desirable chemical decomposition pathways can also provide great societal benefit in applications such as nano-agriculture, in which the use of nanomaterials made from micro- and macro-nutrients can improve plant health and reduce disease while also reducing the quantity of materials required. The Center for Sustainable Nanotechnology, funded via the NSF Chemistry Division's Centers for Chemical Innovation Program, takes a fundamental molecular perspective on questions related to emerging nanomaterials and their environmental and biological interactions. Ultimately the mission of the CSN is to develop and use a molecular-level understanding of nanomaterial properties, their aqueous transformations, and the underlying chemical interactions with living systems to enable the development of emerging nanotechnologies in a sustainable manner for societal benefit.

Bio: Howard Fairbrother received his B.A. from Oxford University, England (1989) and a Ph.D. in physical chemistry from Northwestern University (1994), where he worked with Professors Peter Stair and Eric Weitz. Following a postdoctoral position with Professor Gabor Somorjai at the University of California, Berkeley, he joined the Chemistry Department at Johns Hopkins University in Baltimore in 1997. His main research interests are in environmental science as they relate to carbon based nanomaterials. As a member of the center for sustainable nanotechnology he has working on modifying the surface properties of nanocellulose to improve its dispersion properties while retaining its desirable biodegradability, studying the photochemical properties of carbon dots and exploring the potential to use biodegradation as a means to control the delivery

of nanoscale nutrients for agricultural applications. Professor Fairbrother's other research interests include understanding the elementary bond breaking steps that underpin the growth of nanostructures from organometallic precursors in charge particle deposition strategies. Dr. Fairbrother is a recipient of a Career award from the National Science Foundation in 2000. He has served as the Secretary and Chair of the Colloids and Surface Science Division of the ACS and was elected as an ACS Fellow in 2011. In 2013 he was appointed and still serves as a senior editor for the ACS Journal of Physical Chemistry