

Center for Nanotechnology in Society

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PI: Barbara Herr Harthorn; Co-PIs Rich Appelbaum, Craig Hawker, W. Patrick McCray
University of California, Santa Barbara

The Center for Nanotechnology in Society at UCSB promotes the study of societal issues connected with emerging nanotechnologies in the US and around the globe. Realizing the global vision for nanotechnology to mature into a transformative and beneficial technology depends on an array of interconnected and complex factors situated within a rapidly changing international



economic, political, and cultural environment. These include the resolution of scientific and technological questions, the safe creation, development, and commercialization of nano-products, and the acceptance of nanotechnology by diverse publics. CNS-UCSB serves as a national research and education center, providing a clear and

comprehensive approach to understanding challenges to successful development of nanotechnologies in N. America, Europe, Asia, and Latin America. Through a mixed, complementary portfolio of interdisciplinary research, education, and engagement activities, CNS-UCSB researchers address a linked set of social and environmental issues regarding the domestic US and global creation, development, commercialization, production, consumption, and control of specific kinds of nanoscale technologies. The Center addresses education for a new generation of social science and nanoscience professionals as it fosters research on the origins of the nano-enterprise, globalization of nanotechnology, and multi-stakeholder perceptions of nanotechnologies' benefits and risks.

The Center draws on UCSB's renowned interdisciplinary climate to integrate the work of nanoscale engineers and physical and life scientists with social scientists studying socially responsible development of nanotechnologies. Close ties with the internationally prominent nanoscale researchers at UCSB connected with the California NanoSystems Institute, Materials Research Laboratory, NNIN, UC Center for Environmental Implications of Nanotechnology, and with social science research centers focused on relations among technology, culture, and society are enhanced by research collaborators in the US at UC Davis, UCLA, Decision Research, Drexel U, Duke U, Kauffman Fdn, Lehigh U, Long Island U, Occidental College, Quinnipiac U, Rice U, Science & Technology Policy Institute, Southern Methodist U, SUNY New Paltz, U of AZ, U of S. Carolina, and abroad at Beijing Inst. of Tech., China; Cardiff U, UK; Centre National de la Recherche Scientifique, FR; Compass Resource Management, Canada; Federal U of Parana, BR; Seoul National U, S. Korea; U. Autónoma de Zacatecas, Mexico; U of British Columbia, Canada; U of Edinburgh, UK; U of Gothenburg, Sweden; U of Nottingham, UK; and U of Toronto, Canada.

The Center addresses questions of nanotech-related societal change through research that encompasses three linked areas:

- **IRG 1. Origins, Institutions, and Communities** produces and integrates a diverse range of historical sources and research tools in order to understand specific facets of the nano-enterprise's history.
- **IRG 2. Globalization and Nanotechnology** develops a comprehensive understanding of the role of industrial policy in shaping nanoscale R&D and commercialization in China, Korea,

Japan, Latin America, and the U.S; and the role of multicountry collaborations in high-impact research and commercial innovation.

- **IRG 3. Nanotechnology Risk Perception and Social Response** conducts social research on formative and evolving nanotech risk and benefit perceptions in the US and abroad by multiple stakeholders in the nano-enterprise and develops cross-national modes of enhancing public participation.

IRG 1: Origins, Institutions, and Communities, establishes the historical contexts for the emergence of nanotechnology as a research field, a component of US science policy, and an element in popular imaginings of future technologies. With colleagues at Rice U., S. Methodist U., U. of S. Carolina, U. of Toronto, and Chemical Heritage Foundation, IRG 1 explores topics related to nanotech's history, including research policies for micro/nanoelectronics, what the historical context is for interdisciplinary research in American nanotech labs, how federal research policies have helped foster new areas of research that bridge the physical and life sciences, and the emergence of new research areas such as DNA nanotech. **Recent outcomes:**

- C. M. Mody awarded the Paul Bunge Prize by Gesellschaft Deutscher Chemiker (German Chemical Society) and Deutschen Bunsen-Gesellschaft (German Bunsen Society), 2014, for his book, *Instrumental Community: Probe Microscopy and the Path to Nanotechnology*
- Patrick McCray's book, *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future*, awarded the Watson Davis and Helen Miles Davis Prize, 2014

IRG 2: Globalization and Nanotechnology, focuses on national industrial policies and international collaboration as central factors in the development of nanotech in key Asian countries and the US. The group has extended its research beyond R&D in China to include a comparative study of nanotech policy in Korea, Japan, select Latin American countries, and the US. It has also initiated research that analyzes China's success in commercializing nanotech. IRG2 is also conducting bibliometric analysis of patent and publication data to better understand the determinants of nanotech innovation in China and Latin America. Colleagues at Duke U. have developed a website employing a global value chain (GVC) framework to chart the role of California nanotech in the global economy. This will be expanded to the entire US. **Recent outcomes:**

- Shirley Han, Galen Stocking, Matthew A. Gebbie, and Richard P. Appelbaum. 2014. "Will They Stay or Will They Go? International Graduate Students and Their Decisions to Stay or Leave the U.S. Upon Graduation," in press, 2014, *PLoS ONE*.
- Yasuyuki Motoyama, Cong. Cao, and Richard Appelbaum. 2014. "Observing Regional Divergence in Chinese Nanotechnology Centers," *Technological Forecasting and Social Change* 81 (January): 11-21.

IRG 3: Multi-stakeholder Risk Perception and Social Response, with lead collaborators at U. of British Columbia, Cardiff U., and UCSB, has developed an extensive comparative and longitudinal knowledge base about public, scientist, risk assessment, industry, regulator and NGO perceptions of nanotech and other emerging technologies' risks and benefits. IRG3 also researches modes of engaging diverse members of the public (including women and people of color) in dialogue about new technologies and society. IRG3 collaborates with the UC Center for Environmental Implications of Nanotechnology, providing understandings of public, industry and expert perceptions of potential environmental hazards posed of manufactured nanomaterials. New work in progress includes decision pathway and cross-national surveys on public

perceptions with a focus on benefit perception (with collaborators at Decision Research); completion of public survey research on nano environmental risk perception; gender and race in public participation; traditional and new social medial framing; global collective action and civic engagement about nanotech; and responsible risk communication in conditions of uncertainty.

Recent outcome:

• **Beaudrie, C.E.H., Satterfield, T., Kandlikar, M., Harthorn, B.H.** Scientists vs Bureaucrats: Precaution, Novelty & Politics as predictors of perceived risks of ENMs. PLoS One. Sept 15, 2014. DOI: 10.1371/journal.pone.0106365

Cross-IRG initiatives draw on key UCSB strengths by targeting strategic nanotech application areas in solar and other renewable energy, environment, water, health, and food; spatial analysis and the global value chain; and equitable development.

Education and Public Outreach & Engagement programs at CNS-UCSB aim to nurture an interdisciplinary community of nanoscale scientists & engineers (NSE), social scientists, and educators, and to achieve *broader impacts* through engagement of diverse audiences in dialogue about nanotechnologies and society. In addition to a thriving Postdoctoral Scholars program, CNS-UCSB's unique graduate fellowship program for students in both social sciences and NSE provides research training, mentoring and professional development to a diverse cohort of outstanding students (7-8 fellows per year). Both postdocs and graduate fellows experience outstanding outcomes, finding jobs in academia, research institutes, private foundations, policy institutes, and industry. This year's knowledge transfer activities included sharing information and engaging in dialogue about the novel work pursued by CNS-UCSB with multiple audiences, including campus and academic communities, high school students, general audiences, public policy makers and industry experts. Center researchers and education staff made over 100 outreach presentations during the 2013-14 reporting year. At NanoDays 2014, the Center promoted dialogue between 1,300 members of the general public and NSE researchers through general education about nanotechnology. In February 2014, PI Harthorn provided testimony to the Presidential Commission for the Study of Bioethical Issues on ethics integration in nanotechnology research with reference to the societal aspects of the BRAIN Initiative. CNS-UCSB organized a major conference held at UCSB Nov 13-15 2014 on the roles of nongovernmental organizations (NGOs) in enhancing equitable and sustainable outcomes for new technologies. *Democratizing Technologies: Assessing the Roles of NGOs in Shaping Technological Futures*, brought together representatives of 25 local, national and international NGOs to engage in dialogue about new technologies in society with scholars, scientists and engineers, government representatives and journalists. This conference, attended by over 160 participants, provides a model of engagement between NSE centers and NGOs, vital stakeholders in new technologies in society.



International Collaborations are central to CNS-UCSB's ongoing work and include leading institutions in Brazil, Canada, China, France, Mexico, S. Korea, Sweden, and the UK. CNS-UCSB is a founding member of the Society for the Study of Nanoscience and Emerging Technologies (S.NET), which fosters dialogue among nano and society researchers around the globe. With funding from the UCMEXUS program, CNS-UCSB works with Mexican colleagues to examine bilateral (USA-Mexico) collaborations in the development of nanotechnology.

References [1] For further information see our website at <http://cns.ucsb.edu> or email harthorn@cns.ucsb.edu