

Center for Nanotechnology in Society

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Over the past 10 years, the Center for Nanotechnology in Society at UCSB has promoted 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 have addressed 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 has promoted societally sensitive 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's California NanoSystems Institute, Materials Research Laboratory, NNIN, and UC CEIN, and with social science research initiatives and centers focused on relations among technology, culture, and society, have been enhanced by research collaborators across the US and abroad. Bibliometric analysis indicates CNS-UCSB collaborations span at least 10 countries, and publications from at least 57 countries have cited



CNS-UCSB research.

As the sunset of CNS-UCSB's funding cycle approaches, the Center has initiated a set of linked projects to highlight accomplishments, synthesize and disseminate findings for stakeholder audiences, and reflect on how future endeavors can learn from this experience. CNS-UCSB boasts a strong publications portfolio, with each IRG and cross-IRG collaborations producing publications from CNS-funded and leveraged undergrads, fellows, GSRs, postdocs, faculty, and other collaborating researchers. These include journal articles, entire books and book chapters, conference proceedings, reports, media articles, and film.

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:**

- Hyungsub Choi and Britany Shields (2015). A Place for Materials Science: Laboratory Buildings and Interdisciplinary Research at the University of Pennsylvania. *Minerva*, 53(1), 21-42. doi: 10.1007/s11024-015-9265-6
- W. Patrick McCray, invited presentation on CNS work at the January 2016 World Economic Forum annual meeting in Davos.

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. Extending 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 conducted research that analyzes China's success in commercializing nanotech, with a focus on Suzhou Industrial Park, "China's Silicon Valley." 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:**

- Richard P. Appelbaum, Cong Cao, Rachel Parker, and Denis Simon, *Technology and Innovation in China: China's Evolving Role in the Global Science and Technology System*, book contract signed with Polity Press; anticipated completion winter 2016
- Aashish Mehta advised Asian Development Bank on a large report on skill gaps in Asia

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, benefits, and uncertainties. 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 by manufactured nanomaterials and nanoenabled products. Work approaching completion includes decision pathway surveys in the US and UK; surveys on US public nano environmental risk perception; public deliberations of nanotech and other emerging energy technologies in the US and UK; structured expert decision risk tools; new social media risk framing; and a 10-year synthesis report on the main findings of this research program. **Recent outcomes:**

- Nick Pidgeon, et al. (2015). Creating a national citizen engagement process for energy policy. *Proceedings of the National Academy of Sciences of the United States of America*, 111(Suppl 4), 13606-13613. doi: 10.1073/pnas.1317512111
- Barbara Herr Harthorn provided congressional testimony at the American Chemical Society on “Nanotechnology Policy: Evolving and Maturing,” October 9, 2015.

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. A **recent collaboration** between Grad Fellows in IRGs 2 and 3 analyzes nanotechnology risk perception via social medias and has resulted in several presentations, one publication under review, and two more in preparation.

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 exceptional outcomes, finding jobs in academia, research institutes, private foundations, policy institutes, and industry. This year Center researchers and education staff made over 70 outreach presentations. At NanoDays 2015, the Center promoted dialogue between 1,475 members of the general public (ages 3-90!) and NSE researchers through general education about nanotechnology. CNS-UCSB researchers addressed policymaking bodies including the World Bank and UK Gov’t Cabinet Office. Earlier testimonies of PI Harthorn’s to the Presidential Bioethics Commission and the National Nanotechnology Initiative were integrated into two published reports. CNS-UCSB also self-published a [report](#) based on an international conference held at UCSB Nov 13-15, 2014 on the roles of nongovernmental organizations in enhancing equitable and sustainable outcomes for new technologies.



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 barbara.harthorn@ucsb.edu