

# Multidisciplinary Cognitive Content of Nanoscience and Nanotechnology

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This article examines the cognitive evolution and disciplinary diversity of nanotechnology as expressed through the terminology used in titles of nano journal articles. The analysis is based on the NanoBank bibliographic database of 287,106 nano articles published between 1981 and 2004. We perform multifaceted analyses of title words, focusing on 100 most frequent terms. Hierarchical clustering of title terms reveals three distinct time periods of cognitive development of nano research: formative (1981-1990), early (1991-1998), and current (after 1998). Early period is characterized by the introduction of thin film deposition techniques, while the current period is characterized by the increased focus on carbon nanotube and nanoparticle research. We introduce a method to identify disciplinary components of nanotechnology. It shows that the nano research is being carried out in a number of diverse parent disciplines. Currently only 5% of articles are published in dedicated nano-only journals. We find that some 85% of nano research today is multidisciplinary. Hierarchical clustering of disciplinary components reveals that the cognitive content of current nanoscience can be divided into nine clusters. Some clusters account for a large fraction of nano research and are identified with such parent disciplines as the condensed matter and applied physics, materials science, and analytical chemistry. Other clusters represent much smaller parts of nano research, but are as cognitively distinct. In the decreasing order of size, these fields are: polymer science, biotechnology, general chemistry, surface science, and pharmacology. Cognitive content of research published in nano-only journals is closest to nano research published in condensed matter and applied physics journals.

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