

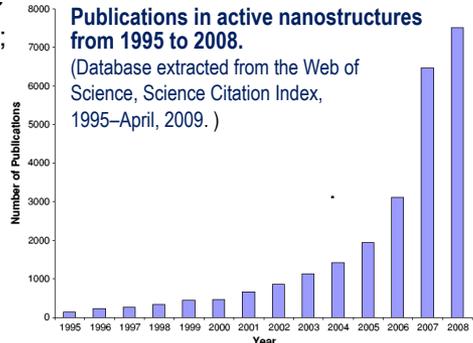
# From passive to active nanostructures: Signs that a major transition is beginning

A critical transition in nanotechnology's developmental trajectory is the anticipated\* shift from passive to active nanostructures. Passive nanotechnologies (such as nanocoatings, nanoparticles, and nanostructured materials) are already available. Second generation active nanostructures (for example, nanoelectro-mechanical systems, nanomachines, self-healing materials, and targeted drugs) can evolve their properties, structure and/or state during their operation. This could increase nanotechnology's impacts and require new approaches for risk assessment.

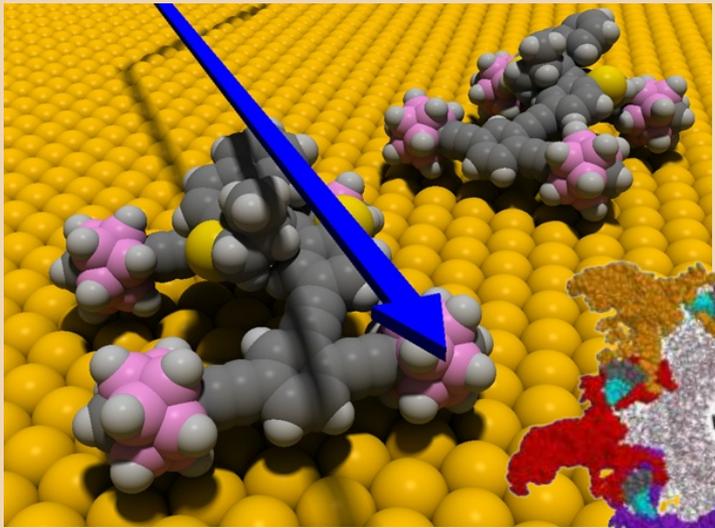
A new CNS-ASU analysis (*Journal of Nanoparticle Research*, January 2010) of global nanotechnology publications verifies that the anticipated shift to active nanostructures is under way. A sharp rise in publications focusing on active nanostructures begins in 2006; this rise accelerates in 2007 and 2008.

Access the entire article at <http://bit.ly/activenano>

\*A shift to active nanostructures is hypothesized by M.C. Roco (2004); see also Tour (2007) (citations in article)



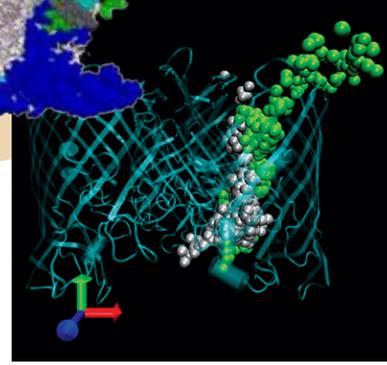
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Active nanostructures are likely to have a different and increased profile of impacts (including benefits as well as potential risks) compared with passive nanotechnologies. The implications for societal, health and safety, and environmental considerations need to be addressed in other studies and in policy and governance processes.

We suggest the following categories of active nanostructures are emerging in the research literature:

- *Remote actuated active nanostructures*, such as light-actuated embedded sensors;
- *Environmentally responsive active nanostructures*, such as responsive drug delivery;
- *Miniaturized active nanostructures*, such as synthetic molecular motors and molecular machines;
- *Hybrid active nanostructures*, or uncommon combinations of materials, such as silicon-organic ;
- *Transforming active nanostructures*, such as self-healing materials.



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