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Horizon Scanning Intelligence Group

Trends in nanotechnology

1. Introduction

The field of Nanotechnology is growing rapidly and some observations on trends in terms of the materials and applications under development are summarised here. This report, which is part of the on-going Horizon Scanning activity within HSE, is intended to provide a 'snapshot' of the current status of developments in the field. The information has been derived from a number of published sources, in combination with an evaluation and analysis of indicators such as patent activity and commercial product availability.

2. Trends and Indicators

2.1 Patent Activity

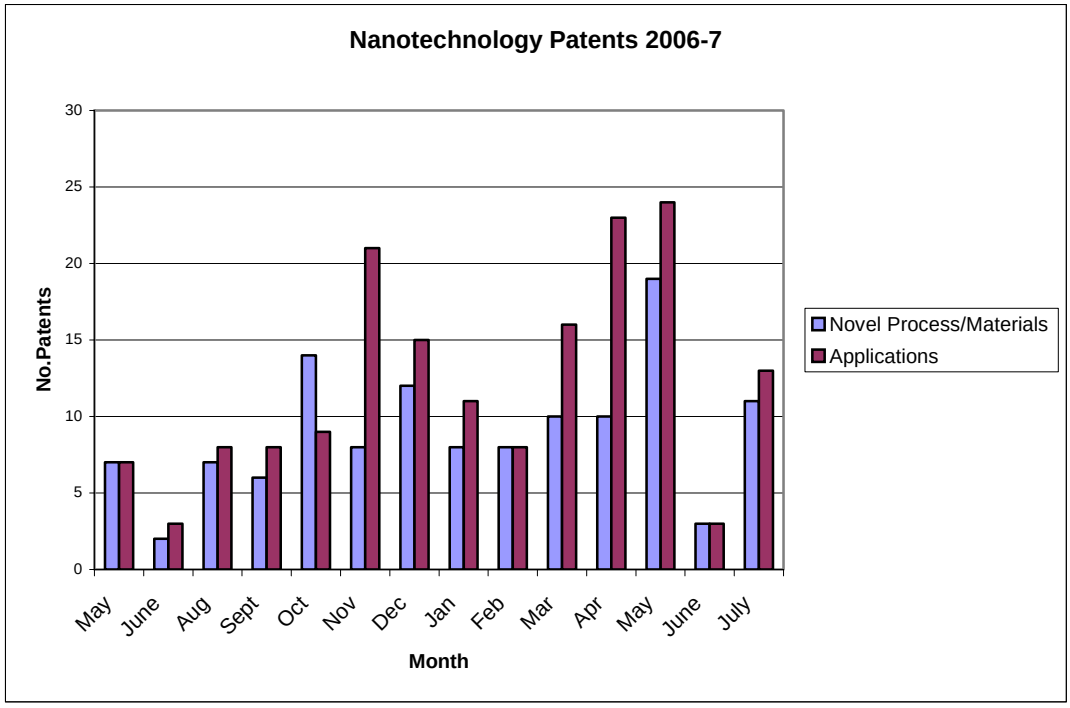
An alert we have set up to track new US Nanotechnology patents[1] indicates that the key areas of activity involve developments in:

Materials – principally metals, metal salts (e.g. oxides, sulphides and selenides) and carbon nanotubes;

Manufacturing Processes – commonly vapour phase (chemical and vapour deposition), together with precipitation, surface treatment and a number of other innovative techniques;

and

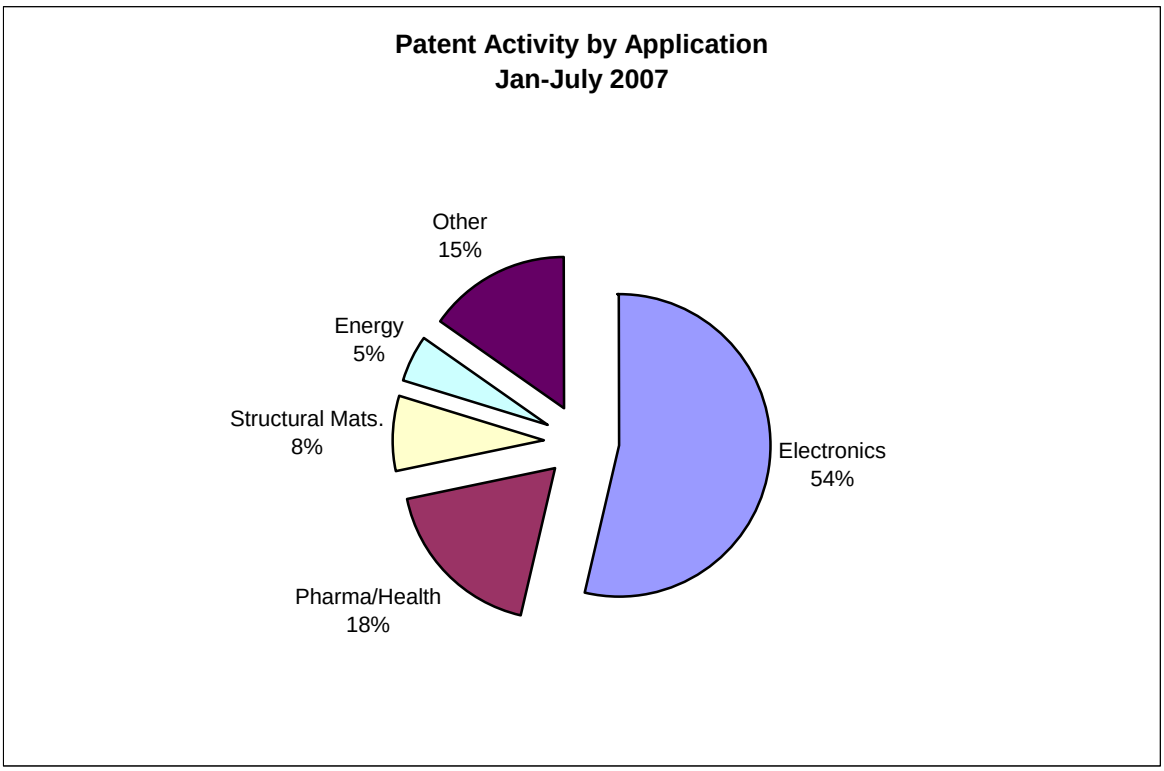
Applications – in e.g. electronics, medical systems (bioassay, drug delivery, diagnostics), optics and composite materials.



[1] The particular alert is limited to patent applications including the terms 'Nanoparticle' and 'Nanotube' and as such is by no means comprehensive but hopefully provides a snapshot of current activity.

An analysis suggests that interest is perhaps starting to shift from the development of new materials and processes more towards the application of the technology to a wide range of products. This would fit with the view expressed elsewhere that developments in Nanotechnology are likely to occur in phases.[2] It may be that as predicted, we are about to enter the second of these phases, in which the technology progresses from limited use in a small number of high end products, to wider application as "commercial breakthroughs unlock markets for Nanotechnology innovations".

The patent activity reviewed here relating to new product applications seems to be focussed mainly on the areas of electronics and pharmaceutical/healthcare. For example, in the first 4 months of 2007, these areas together accounted for almost 80% of the new application-related patents:



2.2 Current Market Applications

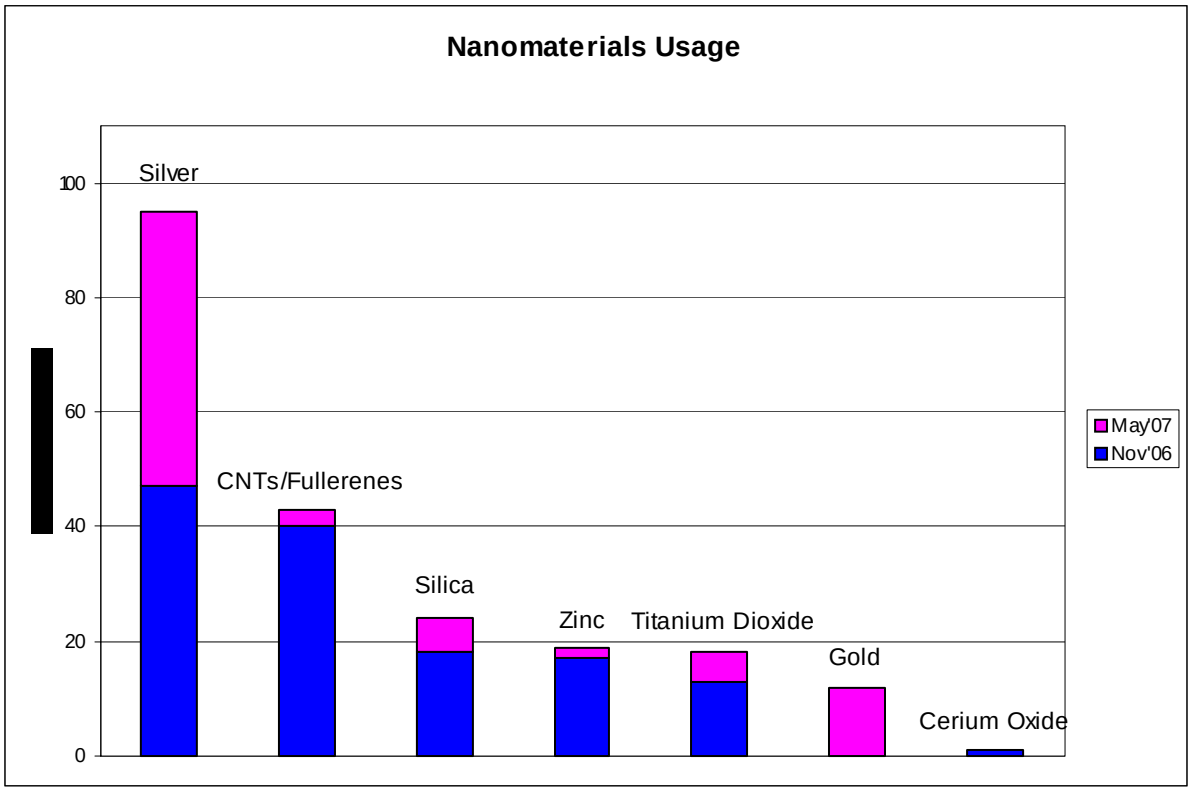
A comprehensive worldwide database of consumer products incorporating Nanotechnology has been constructed and is being constantly updated by the Wilson Center's "Project on Emerging Nanotechnologies".[3] In the period from March 2006 to May 2007, the number of products listed on the database more than doubled, from 212 to 475 and this growth seems set to continue.

An analysis of the data indicates that around 60% of the products on the market at present are found in the "health and fitness" sector and include e.g. cosmetics, sports goods (golf clubs, racquets etc.), sunscreens and clothing. Other categories, all of

[2] See e.g. the OECD report "Opportunities and Risks of Nanotechnologies", available at: http://www.oecd.org/dataoecd/37/19/37770473.pdf
[3] http://www.nanotechproject.org/index.php?id=44

which appear to be growing at a similar rate include electronics and computers, automotive components, items for the home and garden and the food and beverage sectors.

While it is not possible from the data to get any feel for the quantities of the various nanomaterials being consumed in the manufacture of these products, it is interesting to note the breakdown of usage in terms of the number of products associated with specific materials:



It can be seen that at present the largest and fastest growing material in terms of the number of products in which it is being used is nano-particulate silver. The anti-microbial properties imparted by the use of silver are being exploited in a wide range of products from wound dressings, fabrics and coatings through to food supplements and pet products. It has been estimated that in 2005 the worldwide usage of nanoparticulate silver was in the region of 200-400kg but that this may well rise to perhaps 4-6 tonnes per annum by 2010.[4]

2.3 Raw Material Availability

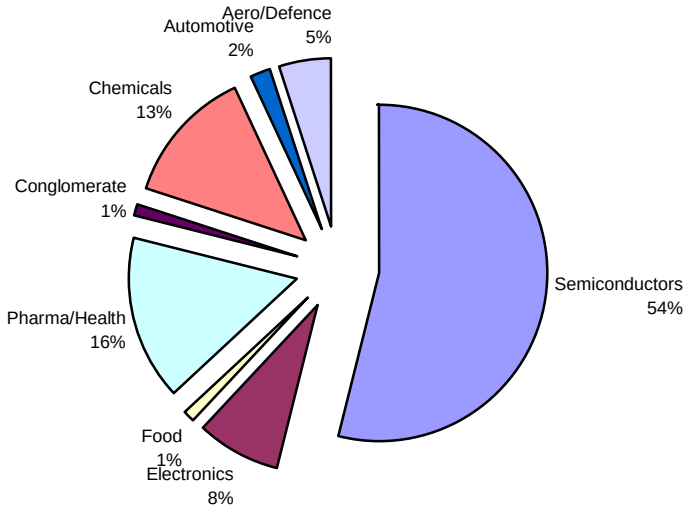
A database of nanomaterials currently lists over 1600 nanoparticles, nanowires, nanofibres, nanotubes and quantum dots, from around 100 manufacturers worldwide (mostly in the US and Far East).[5] This represents an increase in the number of materials available of around 25% in the past 6 months.

[4] Data reported at the NanoRoadMap Seminar 21/11/05 (see http://www.nanoroadmap.it/)
[5] http://www.nanowerk.com/phpscripts/n_dbsearch.php

2.4 Market Projections

A recent report from Cientifica[6] states that "many of the revolutionary and disruptive technologies predicted" by the oft-quoted National Science Foundation projection[7] of a $1trillion market for Nanotechnology by 2015 have so far failed to emerge. However, based on an analysis of the research spend in the field, the Cientifica report finds that "a picture emerges of a maturing technology that is making the transition from a basic building block to one that will enable much higher value added applications". While the bulk of the current market value in nanotechnology (estimated at around $400 million p.a.)[8] is being derived from the sale of the raw materials, this is set to change and it is predicted that applications of the technology in the electronics/semiconductor and pharmaceuticals/health sectors will come to dominate in terms of sales. By 2012, these industries are expected to account for around 80% of the Nanotechnology market value:

The Nanotechnology Market in 2012
(Source: Cientifica)



- and broadly in line with other projections (e.g. ref.8 above) the trillion-dollar market is felt to be achievable by 2015. However, as a word of caution, it should be noted that this figure relates to the finished products and not the value of the nanomaterials incorporated within those products, which may be only a fraction of the total cost, particularly e.g. in the case of high value added pharmaceuticals and electronics components.

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[6] see "Halfway to the Trillion Dollar Market?" at http://www.cientifica.eu/
[7] http://www.nano.gov/html/res/IntStratDevRoco.htm
[8] ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/nanoarticle_hullmann_nov2006.pdf