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Simple way to separate nano-pollutants

By AlphaGalileo

We live in the age of dynamic development of various nanotechnologies. A side effect of t
fact that more and more nanometric structures get into the environment. Many of these st
dangerous for man. Carbon nanotubes may be of length similar to the size of a cell – mor
with a diameter of just several nanometres; such an object acts like a needle and it is hard
body. Nanostructures that have a round shape, made of hazardous materials, e.g. cadmiu
also dangerous. Meanwhile, methods of mechanical and chemical treatment of sewage d
pollutants, whereas laboratory methods are successful only in the case of little volumes o
Physical Chemistry of the Polish Academy of Sciencies (IPC PAS) developed an innovati
process allowing nanometric size pollutants to be separated. The process can be used or
solution turned out to be so simple, cheap and effective that it is already protected by four
Prof. Robert Hołyst, director for scientific affairs of the IPC PAS.

The method for the separation of nanometric particles, developed within the last five years
polluted solution two substances: surfactant (i.e. surface active agent, such as soap) and
and environment-friendly PEG). "If we match concentrations properly, all tiny pollutants w
floating layer with consistency of thin soap, under which there is clean water with polymer
recovered," says D.Sc. Marcin Fiałkowski from the IPC PAS. The upper layer of the surfa
mechanical methods in a simple way, and then it can be utilised or processed in order to r
contains.

The physical mechanism responsible for the separation of the substance in the solution is
difference between geometrical sizes of surfactant and polymer particles. Surfactants – su
dominant components of all cleaning agents – create in solutions aggregates called micel
shapes but they often look like ordinary balls. Polymer, on the other hand, has a form of a
resembles a ball. If two "balls" of a surfactant get close enough to each other, the smaller
be able to squeeze between them and will remain at a certain distance, called radius of gy
micelles of a surfactant approach each other and the distance between them is smaller th
gyration, an empty space is created between them. This results in a difference in concent
osmotic pressure related to this difference. Water flows out from among micelles, they ge
dozens of minutes phases in the solution become separated. The process occurs even w
the same sign is added into the solution containing ionic surfactant.

The research showed that if there were any particles in the original solution, they gathere
surfactant. "During one of the experiments we studied a solution of gold nanoparticles wh
nanometres. After several percent of soap and approx. 10% of polymer had been added,
with a surfactant was created on the surface. It contained particles of gold which, being he
different conditions should fall down to the bottom," describes Ewelina Kalwarczyk, a PhD
Department of Soft Condensed Matter and Fluids of the IPC PAS. The method is effective
detergents that become denser and are raised to the surface.

It is particularly important for the application of this method on an industrial scale that upo
process, polymer remains in water from which it can be nearly completely recovered. The
used up fully is the surfactant, i.e. soap, in which nano-pollutants are closed. Tests which
show any changes in the physical and chemical stability of the surfactant collected, which
contained in it are effectively isolated from the environment.

Surface layer being created in solutions has an orderly hexagonal structure. Since the typ
only on concentration, structures of this type are called lyotropic liquid crystals. Thanks to
described, carefully selected nanoparticles can be easily introduced into matrices that for
matrices can be fixed and the organic part can be removed. Therefore, the method devel
Physical Chemistry of the PAS can be used not only to treat sewage but also to produce
containing admixtures of gold, platinum, silver, semiconductors, carbon nanotubes, etc. T
be used for the construction of solar cells and various types of catalysts, e.g. car catalysts

The Institute of Physical Chemistry of the Polish Academy of Sciences (http://www.ichf.ed
1955 as one of the first chemical institutes of the PAS. The Institute's scientific profile is s
newest global trends in the development of physical chemistry and chemical physics. Scie
conducted in nine scientific departments. CHEMIPAN R&D Laboratories operating as par
produce and commercialise specialist chemical compounds to be used, in particular, in ag
The Institute publishes approximately 300 original research papers annually.

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