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PRESS RELEASE

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Small clumps in the body: how nanoparticles react to proteins

James Bond can be located anywhere. He owes this fact to the nanosensors that find their way into Bond's bloodstream by way of injection in the film “Spectre”. In the real world, too, work is being carried out to achieve this vision. In the blood circuit, there should be no uncontrolled clumping of particles so that fine blood vessels do not become blocked. Scientists at the INM – Leibniz Institute for New Materials have now found out that the protein haemoglobin influences the aggregation of individual gold nanoparticles to form clumps.

When nanoparticles approach and attract each other, they become unstable and form large flakes, visible to the naked eye. Or they remain stable, and each nanoparticle remains separate. This was the opinion of researchers up till now – it was all or nothing. That these are not the only possiblities has been demonstrated by the researchers at the INM: They have discovered that an intermediate status is also possible, where nanoparticles aggregate to form microscopically small, invisible clusters.

The researchers of the INM and the University of Bayreuth recently published their findings in the journal ACS NANO.

Tobias Kraus, a physical chemist at the INM, commented, „The results are of interest in medicine: nanoparticles are used today to bring drugs to precisely where they are needed in the body. This requires that the particles do not aggregate. Only then can they move through the fine ramifications of the blood vessels, for example. Our results show that special care must be taken, since aggregates could be present even though you can't see them,” says Kraus.

In their study, the researchers discovered that the concentration ratio of gold nanoparticles and haemoglobin is decisive in determining if large flakes or microscopically small clusters are formed. In mixtures with high concentrations of nanoparticles and little haemoglobin as well as in mixtures with very few particles and a lot of haemoglobin, microscopically small aggregates formed. With different concentration ratios, the particles all aggregated to form clumps and created visible, dark flakes.

The scientists used light, x-rays and electrons for their microscopic examinations. This permitted them to reveal both the structure of the microscopically small clumps and the structure of the large flakes.

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INM conducts research and development to create new materials – for today, tomorrow and beyond. Chemists, physicists, biologists, materials scientists and engineers team up to focus on these essential questions: Which material properties are new, how can they be investigated and how can they be tailored for industrial applications in the future? Four research thrusts determine the current developments at INM: *New materials for energy application*, *new concepts for medical surfaces, new surface materials for tribological systems* and na*no safety and nano bio*. Research at INM is performed in three fields: *Nanocomposite Technology*, *Interface Materials*, and *Bio Interfaces*.

INM – Leibniz Institute for New Materials, situated in Saarbrücken, is an internationally leading centre for materials research. It is an institute of the Leibniz Association and has about 220 employees.