

Golden nanoglue completes the wonder material

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Credit: University of Oulun

In a recent study, scientists at the University of Oulu have developed a nanojunction, joining one of the most promising novel materials, molybdenum disulfide, with nickel.

Graphene has undoubtedly been the most popular research subject of nanotechnology during recent years. Made of pure carbon, this wonder



material is in principle easy to manufacture: take ordinary graphite and peel one layer off with Scotch tape. The material thus obtained is twodimensional, yielding unique properties, different from those in threedimensional <u>materials</u>.

Graphene, however, lacks one important property, semiconductivity, which complicates its usage in electronics <u>applications</u>. Scientists have therefore started the quest of other <u>two-dimensional materials</u> with this desired property. Molybdenum disulfide, MoS2 is among the most promising candidates. Like graphene, MoS2 consists of layers, interacting weakly with one another. In addition to being a semiconductor, the semiconducting properties of MoS2 change depending on the number of atomic layers.

For the one or few <u>layer</u> MoS2 to be useful in applications, one must be able to join it to other components. What is thus needed is such a <u>metallic conductor</u> that electric current can easily flow between the <u>conductor</u> and the semiconductor. In the case of MoS2, a promising conductor is provided by nickel, which also has other desired properties from the applications point of view.

However, an international collaboration, led by the Nano and molecular systems research unit at the University of Oulu has recently discovered that nanoparticles made of nickel do not attach to MoS2. One needs gold, which 'glues' the conductor and the component together. Says docent Wei Cao of NANOMO: "The synthesis is performed through a sonochemical method." Sonochemistry is a method where chemical reactions are established using ultrasound. NANOMO scientist Xinying Shi adds: "The semiconductor and metal can be bridged either by the crystallized gold nanoparticles, or by the newly formed MoS2-Au-Ni ternary alloy."

The nanojunction so established has a very small electrical resistivity. It



also preserves the semiconducting and magnetic properties of MoS2. In addition, the new material has desirable properties beyond those of the original constituents. For example, it acts as a photocatalyst, which works much more efficiently than pure MoS2. Manufacturing the golden nanojunction is easy and cheap, which makes the new material attractive from the applications point of view.

The article on nanojunctions was published in the leading nanotechnology journal *Small*.

More information: Xinying Shi et al. Metallic Contact between MoS2 and Ni via Au Nanoglue, *Small* (2018). DOI: 10.1002/smll.201704526

Provided by University of Oulun

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