SLASHGEAR

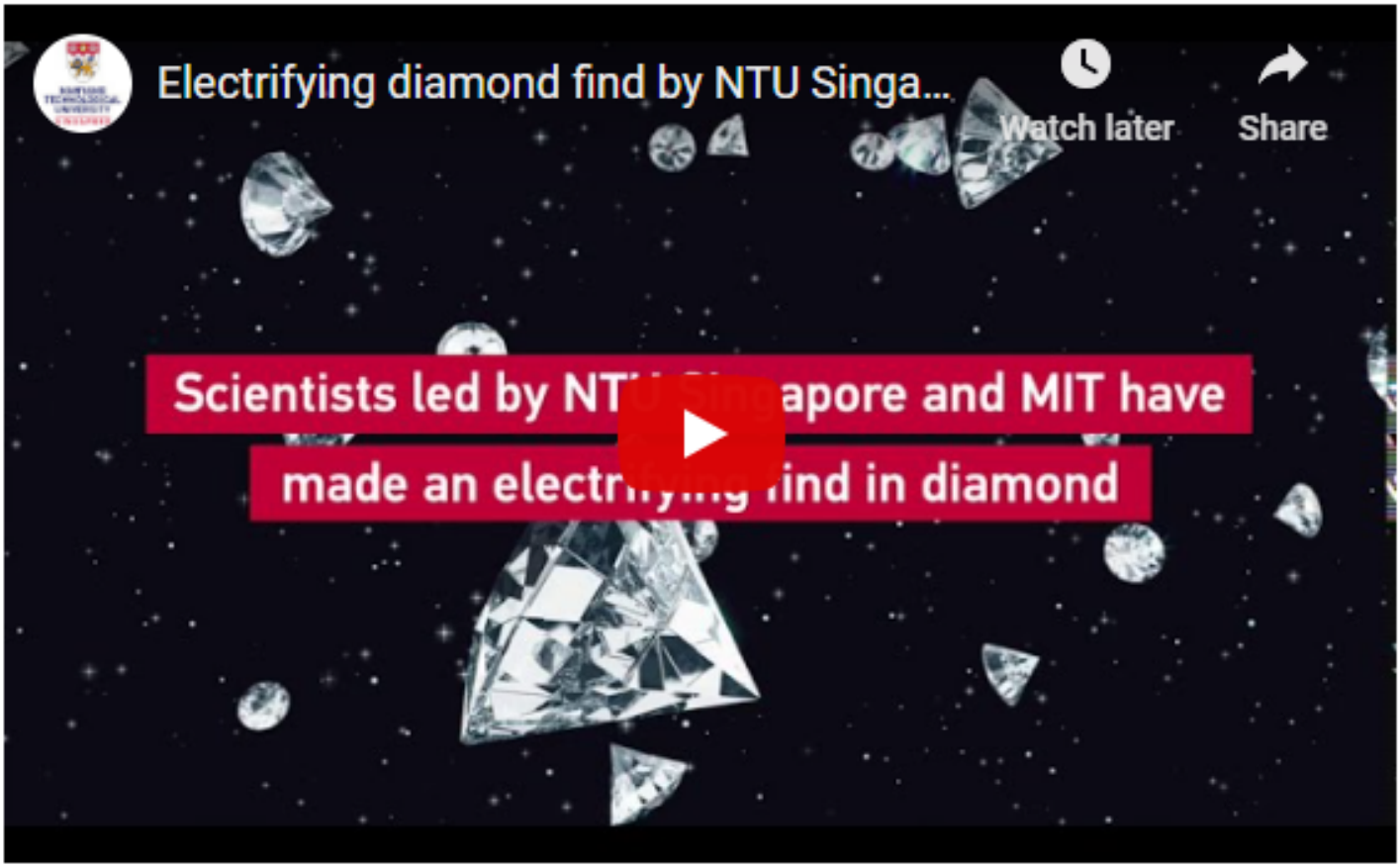
Researchers find diamonds conduct electricity like metals when deformed

Shane McGlaun - Oct 7, 2020, 5:01 am CDT

A group of researchers from Nanyang Technological University in Singapore and MIT in the US, among others, has discovered something interesting about diamonds. The team has discovered that diamond could conduct electricity like metal when deformed to strains at the nanoscale. Computer simulations allow the team to show an early proof of concept that mechanical strain applied to diamond needles can reversibly alter the geometry of the needles and their electrical properties.

Under strain, the needles have a metal-like capability to conduct electricity at room temperature and pressure. Researchers believe the discovery could benefit future applications in power electronics used in a wide variety of devices ranging from cars to appliances and smart grids. Additional applications where the breakthrough could lead to improvements include light-emitting diodes, optical devices, and quantum sensing to improve a sensor's ability to perform its task.

Diamond is one of the hardest materials known to man and has extreme physical properties that could make it a candidate material for use in a wide variety of applications. Any material that allows electricity to flow through easily is an electrical conductor, typically diamond, in most forms, is an electrical insulator because it doesn't allow electricity to flow. Computer simulations performed by the researchers involving quantum mechanics, analyzing mechanical deformation, and machine learning allowed the researchers to discover they could narrow the bandgap of a diamond by elastically deforming it via a diamond probe pushing it from the side.



The simulation showed that as the amount of strain applied to the diamond nano-needle increased, the predicted bandgap narrowed. The narrowing is an indicator of greater electrical conductivity. The bandgap disappeared completely near the maximum amount of strain the needle could withstand before fracturing. Researchers were also able to show the metallization of diamond at the nanoscale was achievable without causing phonon instability or phase transformation from diamond to graphite.