Researchers develop nanometer-thick electromagnetic shielding film using MXene

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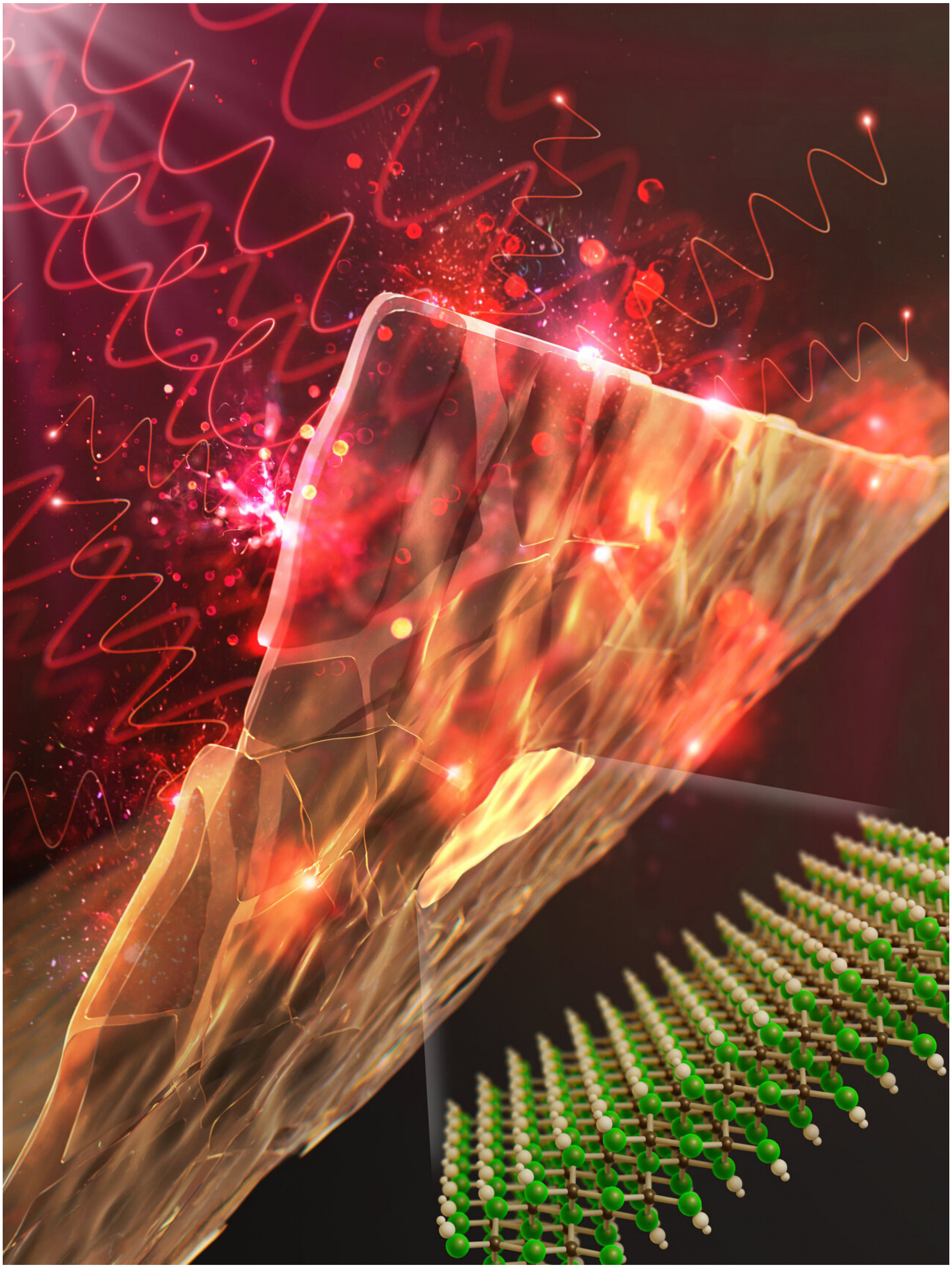

Uniform Nanometer-thick MXene films can be used as electromagnetic shields in flexible electronics and 5G telecommunication devices Credit: Korea Institute of Science and Technology (KIST)

A Korean research team has developed a technology to fabricate an ultrathin material for electromagnetic interference (EMI) shielding. The research team, led by Koo Chong-Min, the head of the Materials Architecturing Research Center at the Korea Institute of Science and Technology (KIST, Acting President Yoon Seok-jin), announced that it had developed an ultrathin nanometer-thick film using MXene, a new two-dimensional nanomaterial for EMI shielding. The research was jointly conducted with a team led by Professor Kim Sang-ouk of the Department of Materials Science and Engineering at Korea Advanced Institute of Science and Technology (KAIST, President: Shin Sung-chul) and a research team led by Professor Yury Gogotsi from Drexel University.

Micrometer-thick MXene films with high electrical conductivity, reported by Koo Chong-min in 2016, present outstanding electromagnetic interference shielding. However, there are no technologies that could be used to directly apply MXene to highly integrated electronic devices, such as 5G communications and mobile devices.

The KIST-KAIST-Drexel joint research team used a self-assembly technique to fabricate an ultrathin MXene film with uniform atomic-scale thickness. MXene film is reported to have exceptional absolute electromagnetic shielding performance (shielding effectiveness relative to thickness and density) that is far greater than that of any other material reported to date.

The figure shows the optical transmittance of multilayer MXene films collected on a glass substrate. One layer of assembled film exhibits a transmittance of 90% at a wavelength of 550 nm. Transmittance gradually decreases with the number of stacked layers, but still remains at 45% for the last-layer film. The absorbance (at 550 nm) increases linearly with the number of stacked layers, ensuring the control of film thickness with ?2 nm accuracy. Credit: Korea Institute of Science and Technology (KIST)

By adding a volatile solution onto the surface of a diluted MXene solution, the research team was able to induce floating MXene flakes. Vertical convection, resulting from differences in surface tension, caused the self-assembly of the micron-sized MXene flakes, thereby creating a large-size ultrathin MXene film with uniform atomic-scale thickness. The research team found that MXene films layered to reach 55 nm in thickness provide 99% electromagnetic shielding efficiency. Ultrathin MXene films fabricated using the team's new technology can easily be transferred onto any substrate and layered multiple times for customized thickness, transmittance, and surface resistance.

"We used a self-assembly technique to fabricate an ultrathin $Ti_3C_2T_x$ MXene film with uniform atomic-scale thickness. This technology helped to examine the electromagnetic shielding mechanism of nanometer-thick 2-D nano materials and to develop an ultrathin electromagnetic shielding application technology for flexible electronics," said Koo Chong-Min, the head of the Materials Architecturing Research Center at KIST. "We believe that the ultrathin coated MXene technology can be applied to various electronic devices and be used for mass production, thereby facilitating research on the application of next-generation lightweight electromagnetic shielding and flexible and printable electronics."

More information: Taeyeong Yun et al, Electromagnetic Shielding of Monolayer MXene Assemblies, *Advanced Materials* (2020). DOI: 10.1002/adma.201906769

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