Magnetic Field-Assisted Nanopatterning of Two-Dimensional Materials for Future Electronics

Mu, Aimee Yixuan (School: Shanghai High School International Division)

After half a century of development, the technology of silicon-based electronic devices is gradually approaching its limits. Devices such as computers and cell phones start to require more power, generating a significant amount of heat. To overcome these problems, scientists are exploring future materials as replacements for silicon. Two-dimensional (2D) materials like graphene and others with unique properties are considered fantastic candidates for future electronics. For example, electrons in graphene behave like light, resulting in very fast movement and generating much less heat. 2D materials have emerged as the forefront of quantum material research in both physics and materials science. To manufacture electronic devices, 2D materials must be patterned into nanostructures. For this purpose, one of the key requirements is etching. The quest for new etching technology suitable for 2D materials has emerged. In this project, I designed and conducted experiments to achieve nanopatterning of graphene by significantly enhancing a newly developed, low-cost, high-efficiency, and environmentally friendly method called the magnetic field-assisted hydroxyl radical etching (MAHRE) method. My research establishes that MAHRE could be a remarkable solution for etching 2D materials at a nanometer scale, not only in research labs but also in the industry for fabricating electronic nanodevices using 2D materials. This advancement will undoubtedly stimulate the application of 2D materials and offer new advantages for information technology, benefiting humankind.

Awards Won:

Fourth Award of $500