Directional Wetting via Nanoscale Striped Amphiphilic Monolayers from Polymerizable Phospholipids

A novel surface chemistry method uses sub-nanometer polymerizable phospholipid films to precisely control wetting and patterning of ultrathin material architectures for nanoscale electronics and organic optoelectronics, compatible with scalable solution-processing techniques like spray coating.

A number of major challenges in materials and surface chemistry relate to patterning thin film structures with nanoscopic dimensions. For instance, nanoscale device design frequently requires patterning of two or more chemically different materials at dimensions less than 10 nm, approaching the molecular scale. Patterning nanoscopic wetting near the molecular scale is especially challenging for synthetic material applications, such as nanoelectronic or organic photovoltaic devices, in which process-induced variability at sub-20-nm scales present a major barrier to continued miniaturization. However, nature routinely utilizes nanoscopic wetting control at similar scales to build interfaces of striking geometric precision and functional complexity, suggesting the possibility of leveraging similar control in synthetic materials.

Researchers at Purdue University have developed a method for controlling ultrathin film structures using sitting phases of polymerizable phospholipids. Such phases are capable of providing nanoscopic directional wetting confinement near the molecular scale for ultrathin films under appropriate deposition conditions or, alternatively, of stabilizing spreading of slightly thicker nanoscopic films. The surface chemistry is compatible with scalable solution-processing methods including spray coating. This method uses monolayers with thicknesses less than 0.5 nm, minimizing electrical resistance in comparison with thicker monolayers. Because the headgroup chemistry is modular, it can be modified to control wetting of a variety of technologically relevant materials including classes of materials relevant to organic optoelectronics or nanoscale electronics.

Advantages:

Technology ID
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Category
Semiconductors/Fabrication & Process Technologies
Materials Science & Nanotechnology/Nanomaterials & Nanostructures
Materials Science & Nanotechnology/Advanced Functional Materials

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-Precise control of ultrathin film architectures

-Modifiable to control wetting of a variety of technologically relevant materials

-Compatible with scalable processing methods such as spray coating

-Sub-nm interlayer chemistry results in minimal electrical barrier

Potential Applications:

-Materials and surface chemistry

-Organic optoelectronics or nanoscale electronics patterning

TRL: 3

Intellectual Property:

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