Drastic improvement in thermal stability of transparent oil-repellent coating

Surface treatment without the use of fluorinated organic compounds

A thermally stable/durable, transparent water/oil repellent coating composed of polymethylsilsesquioxane (PMSQ) was successfully fabricated through a simple sol-gel reaction of methyltriethoxysilane. SEM and AFM confirmed that the resulting coating was smooth (R_{rms} < 0.3 nm). This PMSQ surface showed statically hydrophobic (θ_S= ca. 85°) and oleophilic (θ_S= ca. 35°) properties, but unusually had excellent dynamic dewettability. Small volumes of probe liquids such as water and *n*-hexadecane can be easily set in motion to move across the surface when the substrate tilt angle is ~10° at room temperature. Thanks to thermally stable Si-CH_3 bonds, this excellent water/oil repellency remained even after the thermal treatment up to 350 °C for 24 h in air, which exceeds decomposition temperature of conventional perfluorinated surfaces.

Atsushi HOZUMI
a.hozumi@aist.go.jp

Chihiro URATA
chihiro-urata@aist.go.jp

Materials Research Institute for Sustainable Development

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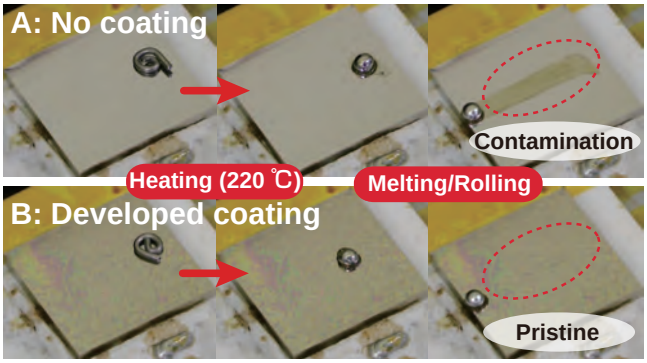

Appearances of rosin core solder on stainless steel plates at 220 °C (plate tilt angle: 5°)
(A) Uncoated stainless steel plate, (B) coated stainless steel plate

Die molded rubber with nanometer-level precision

Arbitrary shapes can be formed on rubber surfaces through the addition of carbon nanotubes

We have developed a technique to allow die molding of a rubber surface with the precision of a few hundred nanometers by adding single walled carbon nanotubes (SWNTs) into the rubber matrix. The die molding processing is superior in productivity and suitable for continuous manufacture and mass production. With the current technology, high precision (nanometer-level) die molding of a rubber surface is difficult. However, we found that a SWNT network structure is formed when long SWNTs are mixed with rubber, and this rubber exhibits high precision surface formability while maintaining its elasticity. Since the network structure of SWNTs is flexible and stretchable like fabric, the elasticity of rubber can be retained even with the addition of SWNTs. Furthermore, the addition of SWNTs allows the rubber to hold arbitrary surface shapes due to reduced mechanical creep properties. This technique is expected to be applied to the development of high functionality rubbers with specifically designed properties, such as wettability, optical, and adhesion, through surface engineering.

Takeo YAMADA
takeo-yamada@aist.go.jp

Atsuko SEKIGUCHI
atsuko-sekiguchi@aist.go.jp

Nanotube Research Center

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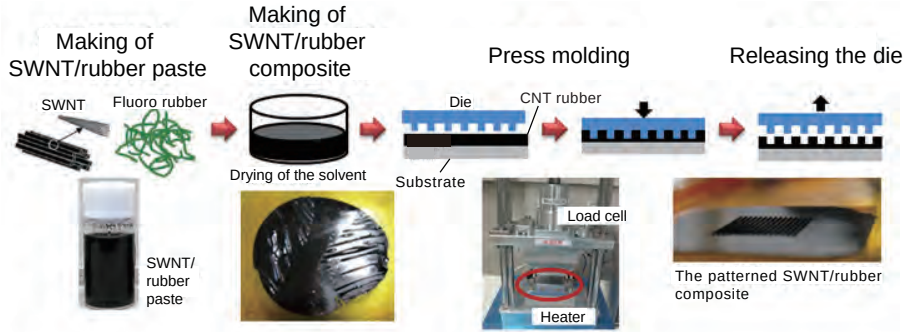

Flow of the manufacturing processes of the SWNT/rubber composite and die molding processing