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Development of graphene and related materials in TASC

TASC perform the development of graphene and related materials for industrial applications. We develop, specifically, CVD graphene atomic layer membranes of nanometer thickness, multilayer graphene films of micron thickness by high-temperature treatment of polymers, and exfoliated graphene dispersion from graphite and its integrated films.

Graphene Atomic Layer Membrane by Plasma CVD [1, 2]

We have achieved realized a graphene membrane with a transmittance of 95% (two-layer) for visible light and sheet resistance of 130Ω (gold chloride doped) by developing an original plasma CVD method. In addition, A4- size light transmittance of 92% (3.6 layers) and sheet resistance 500Ω (without doping) have been achieved. A variety of applications using graphene atomic layer membrane have been being developed by utilizing the characteristics such as electrical conductivity, flexibility, transparency, and chemical resistance.

Multi-layer graphene by high-temperature treatment of polymers.

By high-temperature treatment at more than 3000°C of polymer thin films we have been developing a synthesis method of multilayer graphene of a thickness of $3\mu\text{m} \sim 100\text{nm}$. The multi-layer graphene film produced by our method has very high electrical conductivity of $25,000\text{S}/\text{cm}$ and thermal conductivity of $2,000\text{W}/\text{mK}$ in a planar direction, which are equivalent to single crystal graphite. Along with the synthesis method, we are promoting the development of variety of applications.

Exfoliated graphene dispersion and integrated films by liquid phase process

By exfoliating graphite in the liquid phase we have been developing a synthesis method of high-quality graphene dispersion at a low cost. In order to enable the mass production we have developed an original exfoliation technique which does not use a high-temperature furnace and dangerous chemicals. We have also developed a forming technique of integrated films from graphene dispersion such as self-supporting films without binders, and improved the performance of the films, such as electrical conductivity and so on.





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References

- [1] R. Kato, K. Tsugawa, Y. Okigawa, M. Ishihara, T. Yamada, M. Hasegawa, Bilayer graphene synthesis by plasma treatment of copper foils without using a carbon-containing gas, *CARBON* 77 (2014) 823–828.
- [2] Y. Okigawa, R. Kato, M. Ishihara, T. Yamada, M. Hasegawa, Electrical properties and Domain Sizes of graphene films synthesized by microwave plasma Treatment under a low carbon concentration, *Carbon*, 82(2015) 60-66.

