Graphene Films on SiO_2

Continuous films of multilayer graphene with controllable thickness

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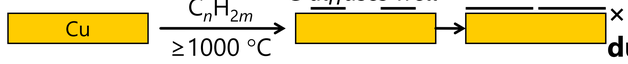
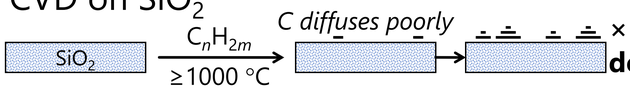
1. Production Methods of Graphene Films

CVD on metal



High quality single-layer on metals
× Graphene films should be damaged during complicated transfer process.

CVD on SiO_2

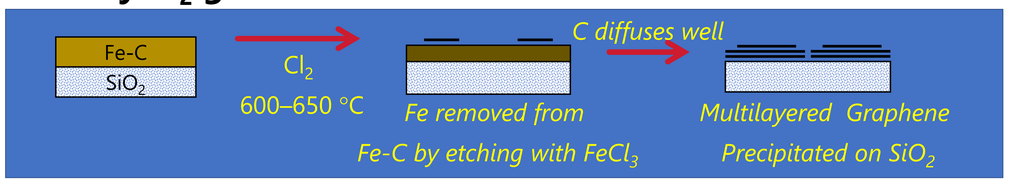


× Only discontinuous film with small domains on SiO_2 can be obtained under the very high temp. process.

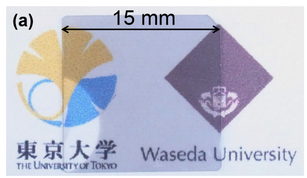
High quality, continuous films with large domains on SiO_2 under moderate temperature process are strongly awaited.

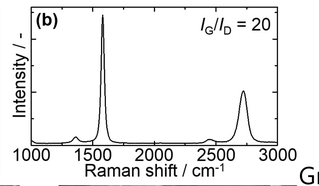
2. Our Technology: Etching-Precipitation Method

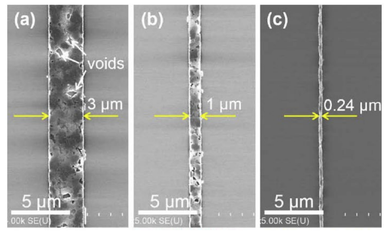
Our method adapts the conventional device fabrication processes. At first, the Fe-C films is sputtered on SiO_2 and then the Fe is etched by Cl_2 gas.



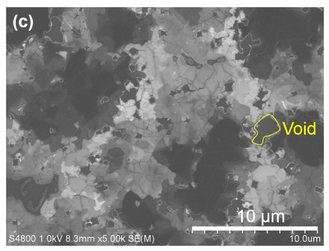
Graphene film formed on SiO_2 at moderate temp. 600 ~ 650 °C.

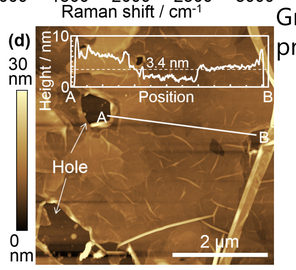






Graphene line pattern formed by lift-off process and by etching & precipitation Method





Transmittance:~ 86% at 550 nm, corresponding to 6–7 layers.

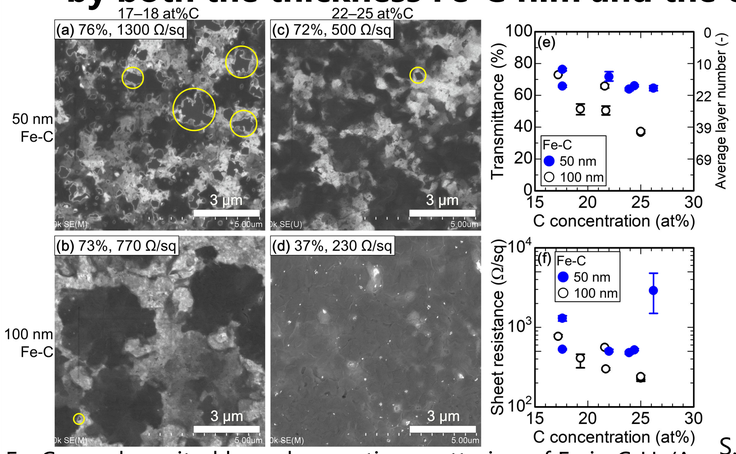
Sheet resistance of 340–460 Ω/sq corresponding to 80–140 μΩ cm.

If the samples had been processed under clean room environment, graphene quality should been improved.

M. Kosaka, et al., Carbon 82 (2015) 254.

3. Controllability of Film Thickness

Thickness of graphene layer can be controlled by both the thickness Fe-C film and the carbon composition of Fe-C film.



Fe-C was deposited here by reactive sputtering of Fe in C_2H_4/Ar.

Average layer number of graphene is varied between 10 and 40.

Sheet resistance is between 300 and 1000 Ω/sq, that will be decreased further to 60 Ω/sq by additional intercalation process with $FeCl_3$.

S. Akiba, et al., Thin Solid Films 675 (2019) 136.

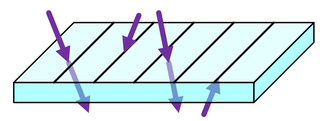
4. Application Examples

Graphene:

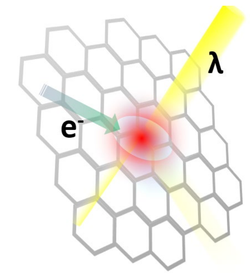
"Transparent, gray or black conductors on glass substrates"

Graphene is optically less shiny and electrochemically more stable than any metals, thus can be used for;

- Transparent electrodes for smart glass, head-up display
- Transparent heaters for glass windows
- Micro-wires of integrate circuits with high current capacity
- High-speed on-chip blackbody emitter for optical communication



Black graphene grids; conductive, glare-free, stable



Light & heat emitter

Nat. Commun. 9 (2018) 1279.

5. Patent Licensing Available

Patent No.: WO2012/118023 (JP, US, EP, KR, CN, IN)

JST/ IP Management and Licensing Group

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