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S E M I N A R
on
Semiconductor Physics and Nanotechnology

<u>Mo, 04.05.2026, 11:15 Uhr</u>,

Seminar in
person in the physics lecture hall *or* via Zoom

"Realizing Scalable Chemical Vapour Deposition of Monolayer Graphene Films on Iron with Concurrent Surface Hardening by *in situ* Observations"

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Graphene has been suggested as an ultimately thin functional coating for metallurgical alloys such as steels. However, even on pure iron (Fe), the parent phase of steels, growth of high quality graphene films remains largely elusive to date. We here report scalable chemical vapour deposition (CVD) of high quality monolayer graphene films on Fe substrates.[1] To achieve this, we here elucidate the mechanisms of graphene growth on Fe using complementary *in situ* X-ray diffractometry (XRD) and *in situ* near ambient pressure X-ray photoelectron spectroscopy (NAP XPS) *during* our scalable CVD conditions. As key factors that set Fe apart from other common graphene CVD catalyst supports such as Ni or Cu, we identify that for Fe (i) carbothermal reduction of persistent Fe-oxides and (ii) kinetic balancing of carbon uptake into the Fe during CVD near the Fe-C eutectoid because of the complex multi-phased Fe-C phase diagram are critical. Additionally, we establish that the carbon uptake into the Fe during graphene CVD is not only important in terms of growth mechanism but can also be advantageously utilised for concurrent surface hardening of the Fe during the graphene CVD process, akin to carburization/case hardening. Our work thereby forms a framework for controlled and scalable high-quality monolayer graphene film CVD on Fe incl. the introduction of concurrent surface hardening during graphene CVD. Additionally, we will briefly introduce how such CVD graphene coatings can, depending on substrate, show a hithertho unreported controllable freezing transparency for water ice on scalable graphene films on metals.[2]

[1] B. Fickl, W. Artner, D. Matulka, J. Rath, M. Nastran, M. Hofer, R. Blume, M. Hävecker, A. Kirnbauer, F. Fahrnberger, H. Hutter, D. Zhang, P. H. Mayrhofer, A. Knop-Gericke, B. Roldan Cuenya, R. Schlögl, C. Dipolt, D. Eder, B. C. Bayer. *Realizing Scalable Chemical Vapor Deposition of Monolayer Graphene Films on Iron with Concurrent Surface Hardening by In Situ Observations, ACS Appl. Mater. Interfaces*, 18, 8567, (2026), https://doi.org/10.1021/acsami.5c18706

[2] B. Fickl, T. M. Seifried, E. Rait, J. Genser, T. Wicht, J. Kotakoski, G. Rupprechter, A. Lugstein, D. Zhang, C. Dipolt, H. Grothe, D. Eder, B. C. Bayer.*Controllable Freezing Transparency for Water Ice on Scalable Graphene Films on Copper*, arXiv, https://doi.org/10.48550/arXiv.2403.15629

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Zoom – Link:

https://zoom.us/j/96375934537?pwd=RTlKTWhSdzRHU211YTY1bGFxTUtpZz09

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