TT 22: Graphene: Fabrication (Joint session of DS, DY, HL, MA, O and TT organized by HL)

Time: Monday 17:45–18:45 Location: H17

TT 22.1 Mon 17:45 H17

Growth and characterization of mono- and bilayer graphene nanoribbons grown on SiC(0001) — •Lauren Aranha Galves, Joseph Wofford, Uwe Jahn, João Marcelo J. Lopes, and Henning Riechert — Paul-Drude-Institut für Festkörperelektronik, Hausvogteiplatz 5-7, 10117 Berlin, Germany

Graphene Nanoribbons (GNRs) are promising for applications in nanoelectronics due to their unique properties. Unlike graphene sheets, GNRs possess a bandgap and the gap is inversely proportional to their width [1]. Additionally, bilayer GNRs offer the possibility to further tune their bandgap via the application of an external electric field [2]. The thermal decomposition of SiC surfaces is a suitable synthesis method for GNRs due to the control it offers over their size [3].

In this report we present the structural characterization of mono- and bilayer GNRs grown on SiC(0001) by surface graphitization. Bilayer GNRs were obtained via a post-growth air-annealing process [4]. The width of the ribbons were determined via atomic force microscopy (AFM) height and phase imaging as well as scanning electron microscopy (SEM), while the number of layers (i.e. mono or bilayer GNRs) were examined by Raman spectroscopy. Based on these measurements it was possible to identify an activation energy for the formation of the nanostructures and a lateral etching effect in the bilayer GNRs due to the air-annealing process.

[1] Barone et al., Nano Lett. 6, 2748 (2006); [2] Li et al., Eur. Phys. J. 64, 73 (2008); [3] Sprinkle et al. Nat. Nanotechnol. 5, 727 (2010); [4] Oliveira Jr. et al., Nat. Comm. 6, 7632 (2015).

TT 22.2 Mon 18:00 H17

Optoelectronic Properties of Graphene Nano-Ribbons Patterned By Helium Ion Beam Lithography — •Akshay Kumar Mahadev Arabhavi[1], Andreas Brenneis[1,2], Simon Drieschner[1,2], Marcus Altzschner[1], Helmut Karl[3], Jose Garrido[1,2], and Alexander Holleitner[1,2] — [1]Walter Schottky Institut and Physics-Department, Technical University Munich, Am Coulombwall 4a, 85748 Garching, Germany. — [2]Nanosystems Initiative Munich (NIM), Schellingstr. 4, 80799 Munich, Germany. — [3]Institute of Physics, University of Augsburg, 86135 Augsburg, Germany.

High electron mobility, excellent thermal conductivity and uniform absorption in the visible range makes graphene an outstanding material for high-frequency optoelectronic applications. However, the lack of a band gap limits graphene in switching applications. A quantization energy can be introduced by confining graphene to one-dimensional ribbons of widths below 20 nm, for instance, using Helium Ion Beam Lithography (HIBL) [1-2]. We have optimized the parameters to pattern graphene nano-ribbons on sapphire substrates using HIBL, such as dose, beam current, spot control and dwell time. Moreover, we apply an ultrafast photocurrent spectroscopy [3] to investigate the optoelectronic properties of the patterned graphene nano-ribbons with respect to their high-frequency properties. References: [1] M. Han et al., Phys. Rev. Lett. 98, 206805, (2007). [2] Bell DC et al., Nanotechnology 20, 455301, (2009). [3] A. Brenneis, et al., Nature Nanotech, 10, 135, (2015).

TT 22.3 Mon 18:15 H17

High quality bilayer graphene from chemical vapor deposition on reusable copper — •Michael Schmitz[1], Stephan Engels[1,2], Luca Banszerus[1], Kenji Watanabe[3], Takashi Taniguchi[3], Bernd Beschoten[1], and Christoph Stampfer[1,2] — [1]JARA-FIT and 2nd Institute of Physics, RWTH Aachen University, 52074 Aachen, Germany — [2]Peter Grünberg Institute (PGI-9), Forschungszentrum Jülich, 52425 Jülich, Germany — [3]National Institute for Materials Science, 1-1 Namiki, Tsukuba 305-0044, Japan

We recently introduced a dry transfer method for single-layer graphene grown by chemical vapor deposition (CVD) yielding ultra high quality graphene comparable to the best exfoliated samples [1]. Here, we demonstrate that this method can be extended to bilayer graphene. In particular, we show the fabrication and characterization of bilayer graphene/hexagonal boron nitride heterostructures using high quality CVD bilayer graphene grown on reusable copper foils. Raman measurements reveal a high structural quality [2]. We achieve carrier mobilities up to 45,000 $cm^2/(Vs)$ at 1.8 K and up to 17,000 $cm^2/(Vs)$ at room temperature outperforming all state-of-the-art CVD bilayer graphene devices. Finally, we show dual-gated transport measurements to investigate band-gap opening in our CVD grown bilayer graphene.

[1] L. Banszerus, M. Schmitz, S. Engels *et al.*, Science Advances **1**, e1500222 (2015)
[2] C. Neumann, S. Reichardt, P. Venezuela *et al.*, Nature Communications **6**, 8429 (2015)

TT 22.4 Mon 18:30 H17

Graphene-based fast hot-electron bolometer with bandwidth from THz to VIS — Martin Mittendorff[1,2], Josef Kamann[3], Jonathan Eroms[3], Dieter Weiss[3], Christoph Drexler[3], Sergey D. Ganichev[3], Jochen Kerbusch[2], Artur Erbe[2], Ryan J. Suess[1], Thomas E. Murphy[1], Jacob C. König-Otto[2,4], Harald Schneider[2], Manfred Helm[2,4], and •Stephan Winnerl[2] — [1]University of Maryland, College Park, USA — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [3]Universität Regensburg, Regensburg, Germany — [4]Technische Universität Dresden, Dresden, Germany

We present a fast detector (rise time 40 ps) operating at room temperature that is capable to detect radiation from the THz to visible spectral range (demonstrated wavelengths 500 μm - 780 nm) [1]. The detector consists of a CVD-grown graphene flake contacted by a broadband logarithmic periodic antenna. SiC acts as a substrate material that does not interfere with the detection mechanism in the desired frequency range, even within the Reststrahlen band of SiC (6 - 12 μm). The detector is ideal for timing purposes. Near infrared (mid- and far infrared) pulse energies of the order of 10 pJ (1 nJ) are sufficient to obtain good signal-to-noise ratios. We suggest that the bandwidth is limited by the antenna dimensions (typically several mm) on the long wavelength side and by the bandgap of SiC (380 nm) on the short wavelength side.

[1] M. Mittendorff et al., Opt. Express 23, 28728 (2015).