

Translating Innovations in 2D-Materials into Commercial Successes

Niraj Singh

Avery Luedtke, Jia Choi, Adelina Braun

MilliporeSigma, 6000 N. Teutonia Avenue,
Milwaukee, WI 53209 USA

niraj.singh@sial.com

Graphene and two-dimensional (2D) materials research continues to grow at a frenzied pace due to the unique physical and electronic properties of these materials. This makes them promising for diverse applications including biomedical research, sensing, coating, energy harvesting, and storage [1-3]. Merck KGaA, which includes the Sigma-Aldrich brand, has developed a diverse portfolio of high-quality graphene and inorganic 2D materials beyond graphene. This talk will highlight examples of our R&D innovations to expand the suite of printable 2D nanomaterial inks, including graphene, MoS₂, and hBN for applications in sensors, photodetectors, and lithium ion batteries.

For example, we have recently commercialized a photonicallly annealable graphene ink for inkjet printing for use in printed and flexible electronics. Graphene is a remarkable material for printed electronics, offering a chemically stable, mechanically flexible, and electrically conductive alternative to conventional metal nanoparticle and conductive polymer inks. The inkjet printing of graphene ink formulations using rapid intense pulsed light (IPL) annealing is well suited for rapid roll-to-roll fabrication of graphene patterns on a variety of substrates.

The scalable and reproducible production of 2D materials, including graphene, is critical for the advancement of commercial applications. In the second half of the presentation we will highlight advancements in the scalable and cost-

effective production of graphene and other 2D materials.

References

- [1] Roldán, R.; Chirulli, L.; Prada, E.; Silva-Guillén, J. A.; San-Jose, P.; Guinea, F. *Chem. Soc. Rev.*, 46 (2017) 4387.
- [2] Chen, D.; Feng, H.; Li, J. *Chem. Rev.*, 112 (2012) 6027.
- [3] Chung, C.; Kim, Y-K.; Shin, D.; Ryoo, S-R.; Hong, B. H.; Min, D-H. *Acc. Chem. Res.*, 46 (2013) 2211.