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Raman-based Quantitative Point Defect Density Comparison in Graphenic System

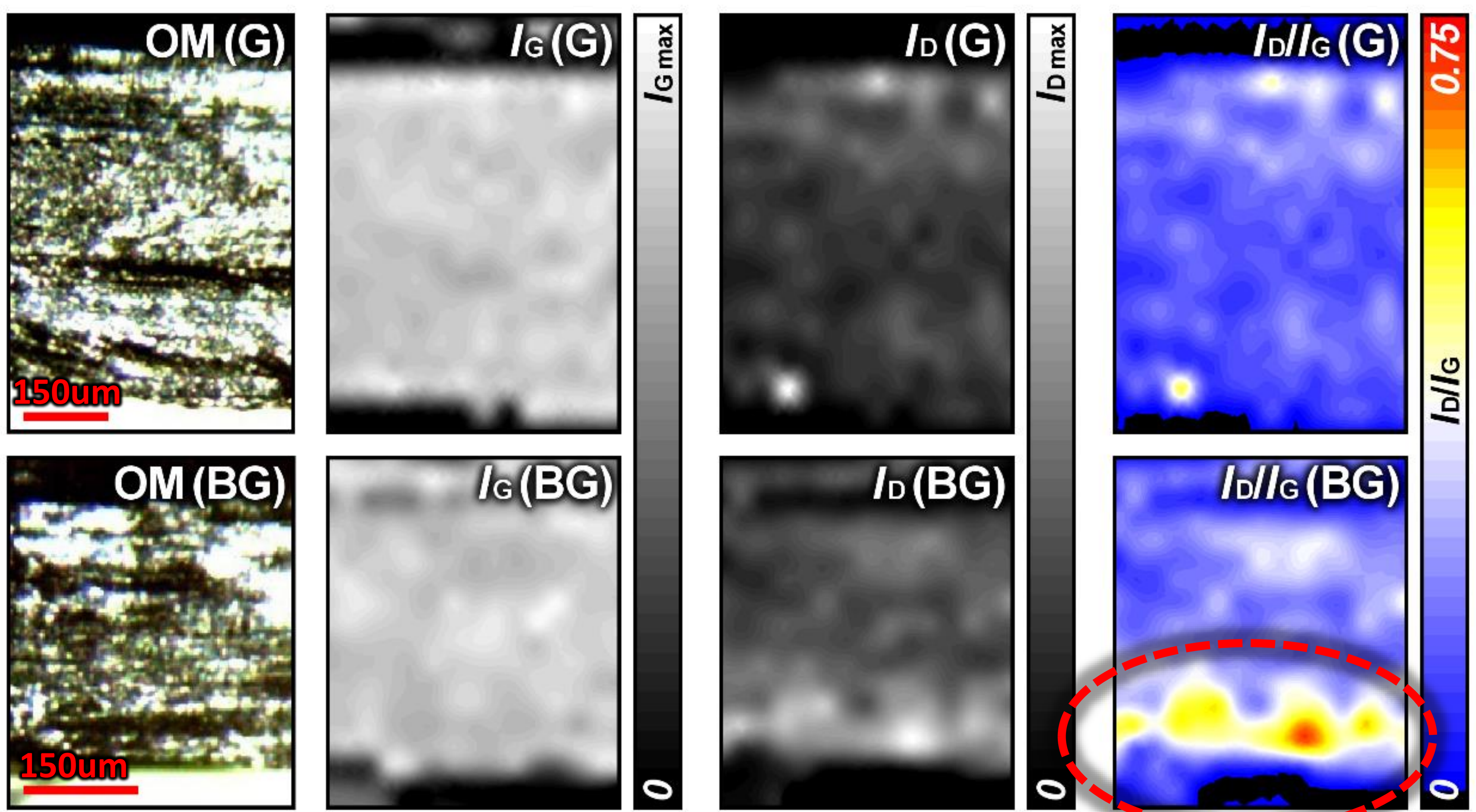
Kazunori Fujisawa, Cheon-Soo Kang,
Takuya Hayashi, Mauricio Terrones
Shinshu University, 4-17-1 Wakasato, Nagano-city, Japan
Penn State University, University Park, Pennsylvania 16802, United States

SHINSHU UNIVERSITY

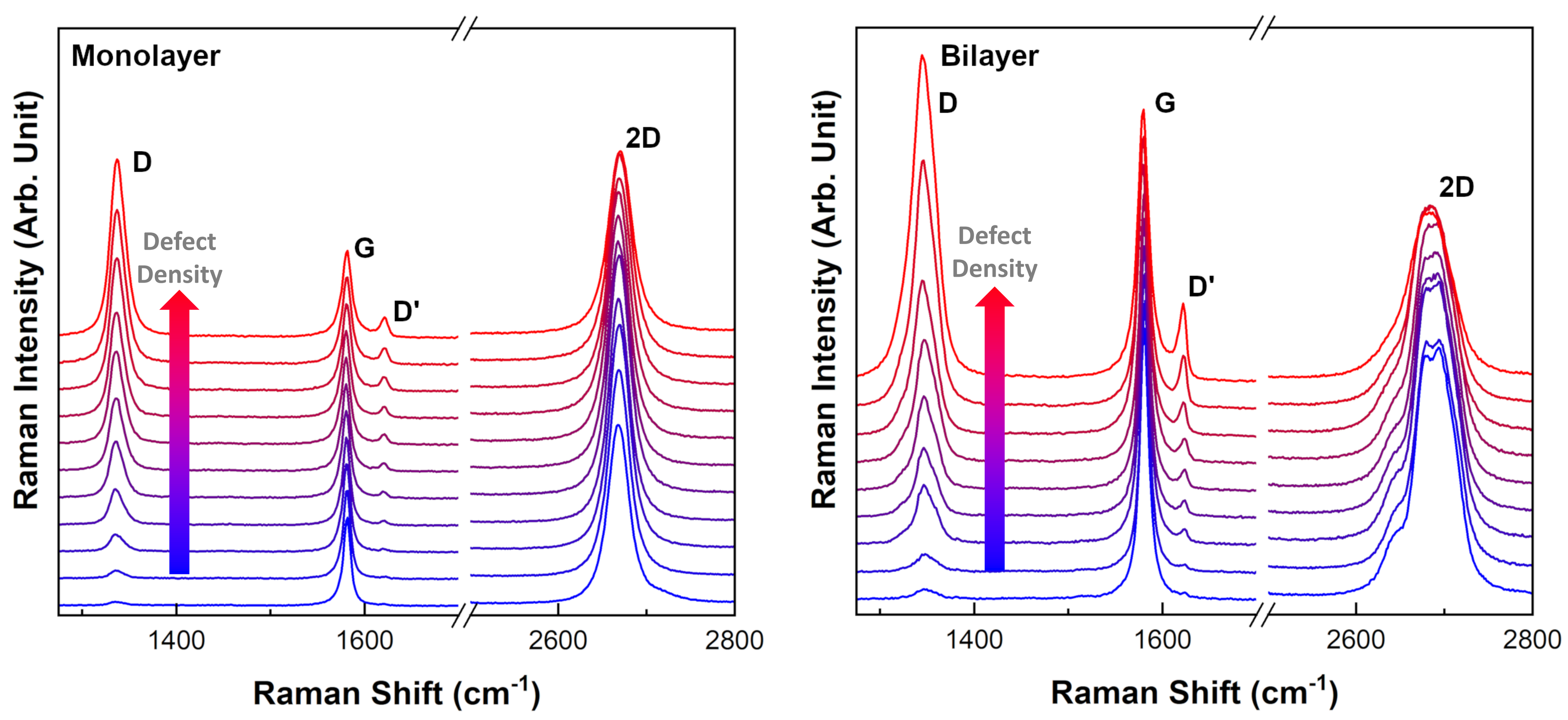
Research Initiative for Supra-Materials

Although exhaustive efforts have been devoted to understanding the correlation between Raman feature and defect density and layer count [1], a unified solution for the defect density evaluation in graphenic materials has not yet been proposed. In this study, following the previous report [2], the substitutional boron atoms were introduced into bulk graphite flake using thermal diffusion of a boron atom. After doping process, mechanical exfoliation was performed to obtain mono-to-few-layered graphenic materials. Detailed Raman spectroscopic analysis and collected more than 10k spectra revealed that data collected from graphenic materials that possess the same defect density (n_D) form a line on the plane of A_D/A_G–A_{2D}/A_G. Finally, a generalized equation to calculate defect density (n_D) or average inter-defect distance (L_D) was proposed.

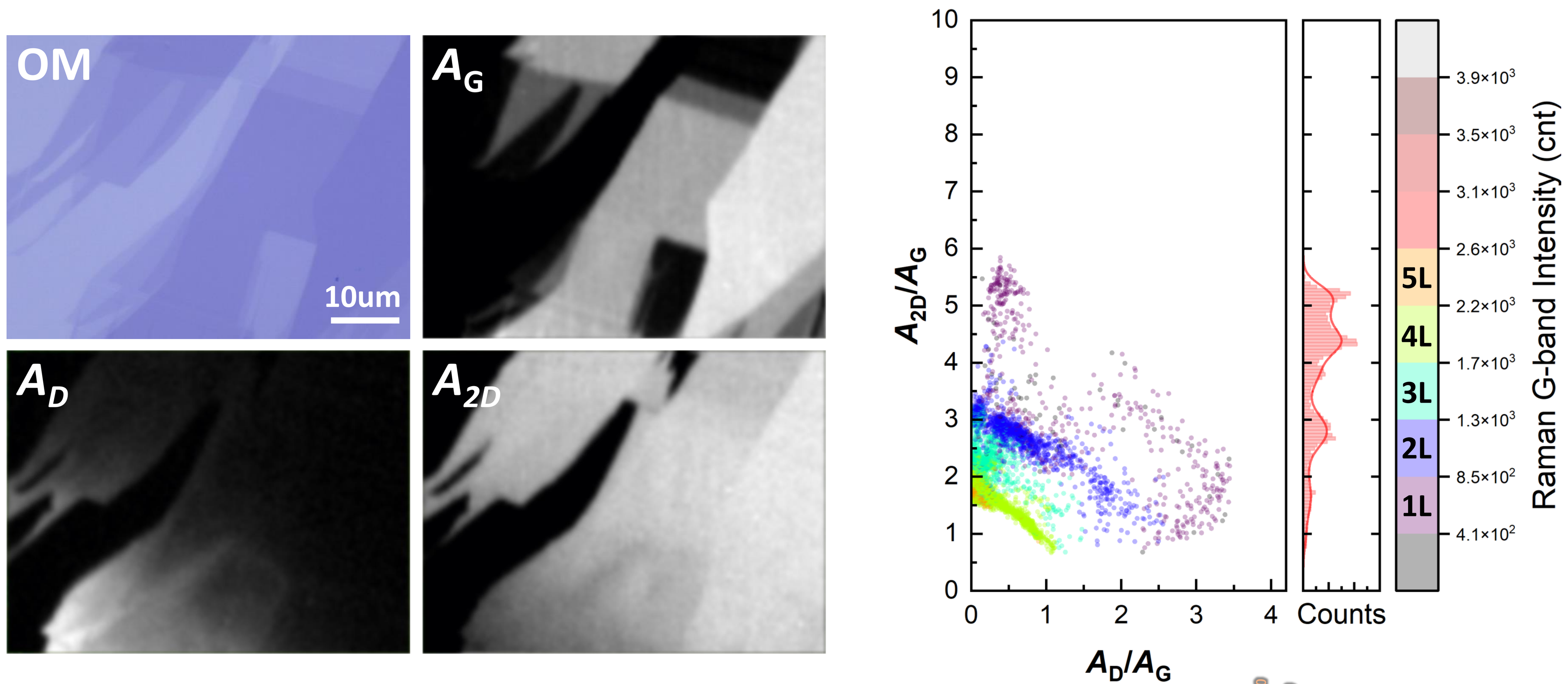
High Quality Doped-Graphite

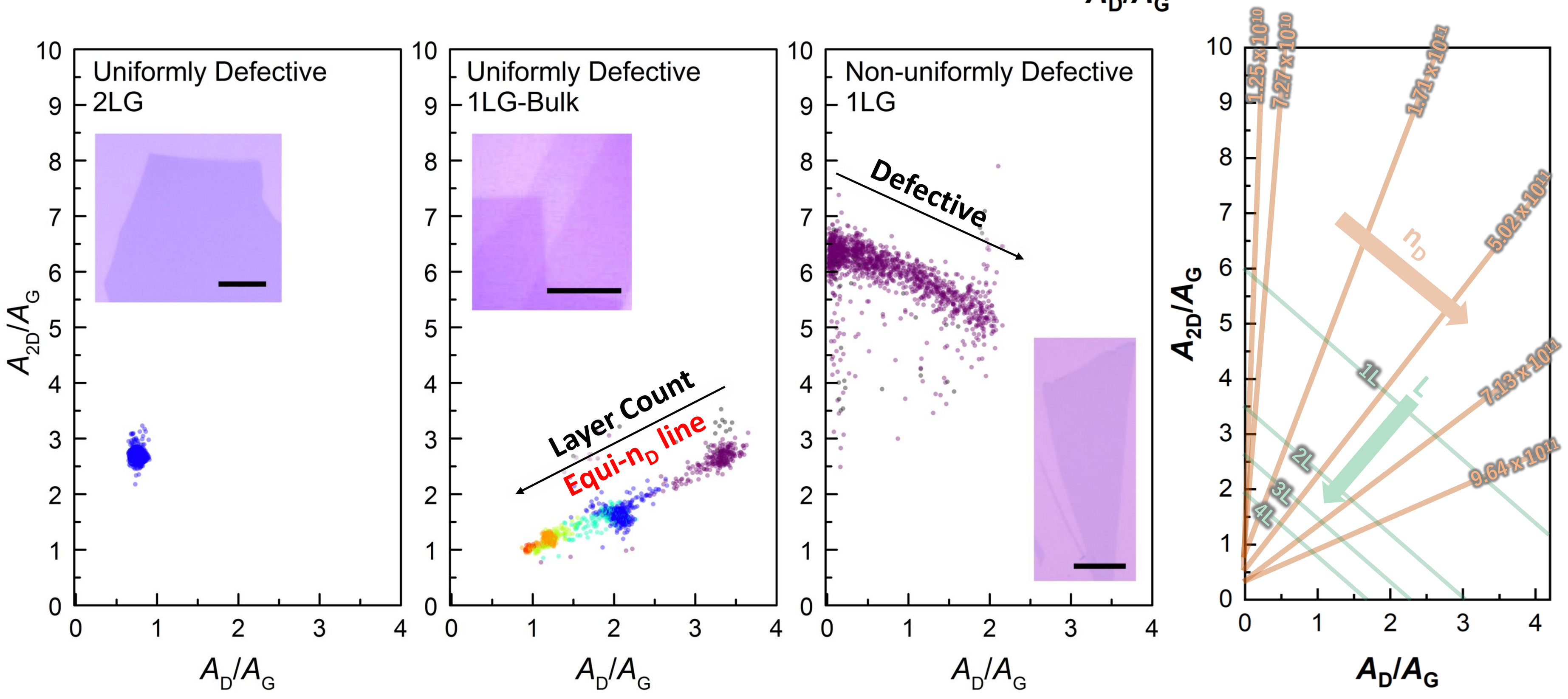


Exfoliated Doped-Graphene

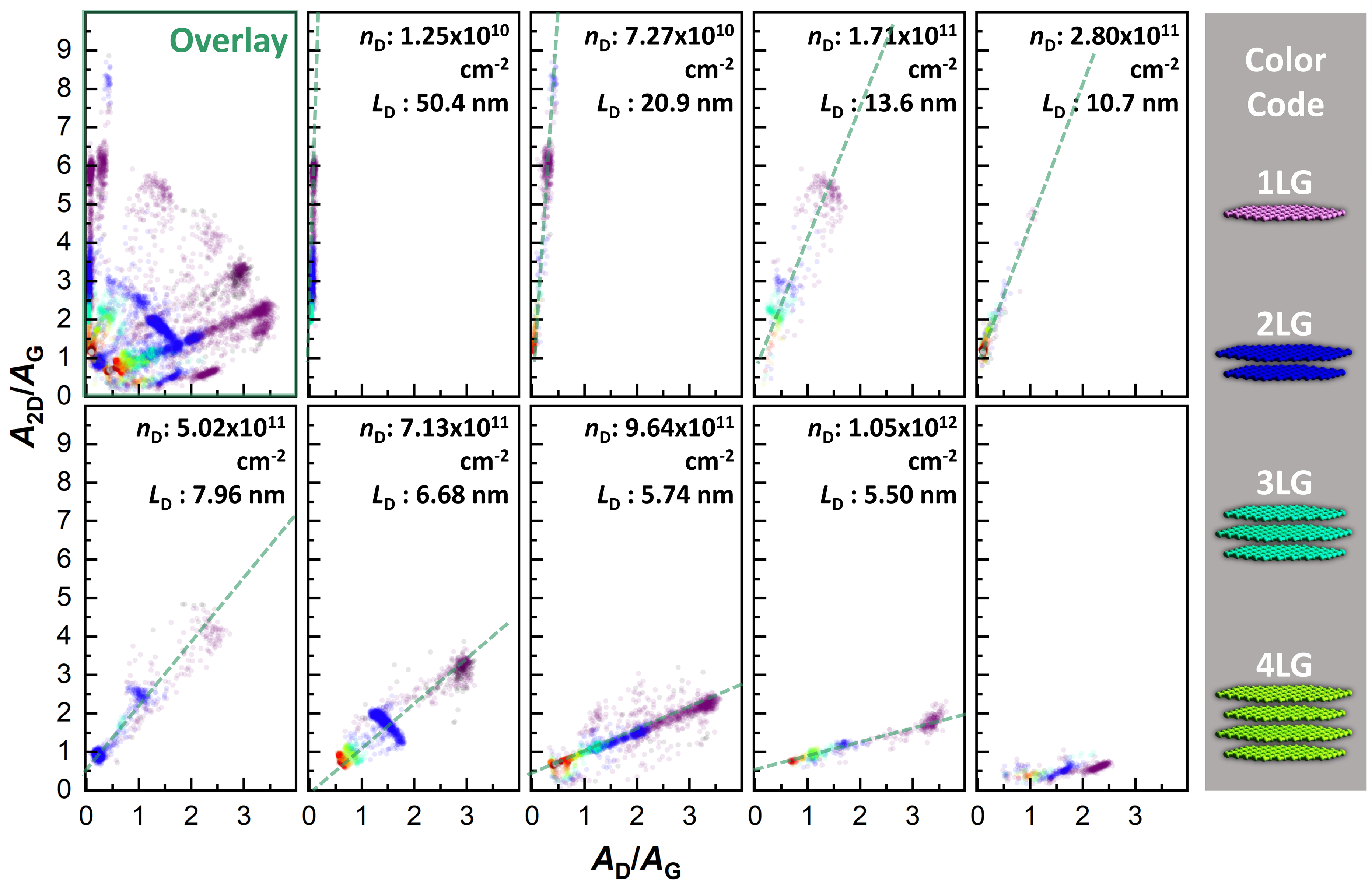


Raman Data Pattern Analysis





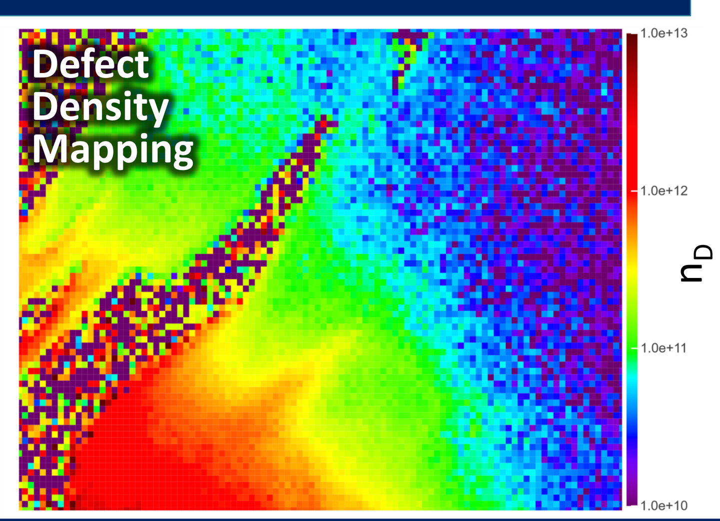
Experimental Calibration of Equi-n_D Line



Conclusion

$$\left(\frac{A_{2D}}{A_G}\right) = \frac{(L_D^2)^{1.13}}{92.1}\left(\frac{A_D}{A_G}\right) + 0.533\,,\ L_D\ (\mathrm{nm})$$

$$\left(\frac{A_{2D}}{A_G}\right) = \frac{1}{92.1}\left(\frac{10^{14}}{\pi n_D}\right)^{1.13}\left(\frac{A_D}{A_G}\right) + 0.533\,,\ n_D\ (\mathrm{cm}^{-2})$$



CONTACT PERSON

Kazu Fujisawa
Shinshu University
Kfujisawa@shinshu-u.ac.jp

REFERENCES

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[2]. Kim, Y. A. et al. ACS Nano 6 (2012), 6293–6300.

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