

SIZE SORTING OF CELLULOSE NANOCRYSTAL FOR GRAPHENE EXFOLIATION

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Introduction

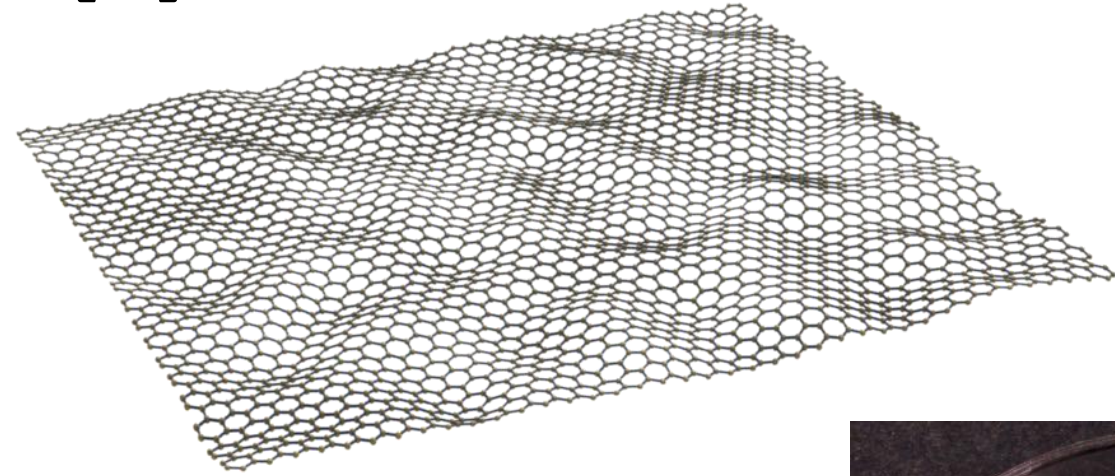
Cellulose nanocrystals (CNC)

- Inexhaustible
- Easy to produce
- Biocompatible, biodegradable [1]



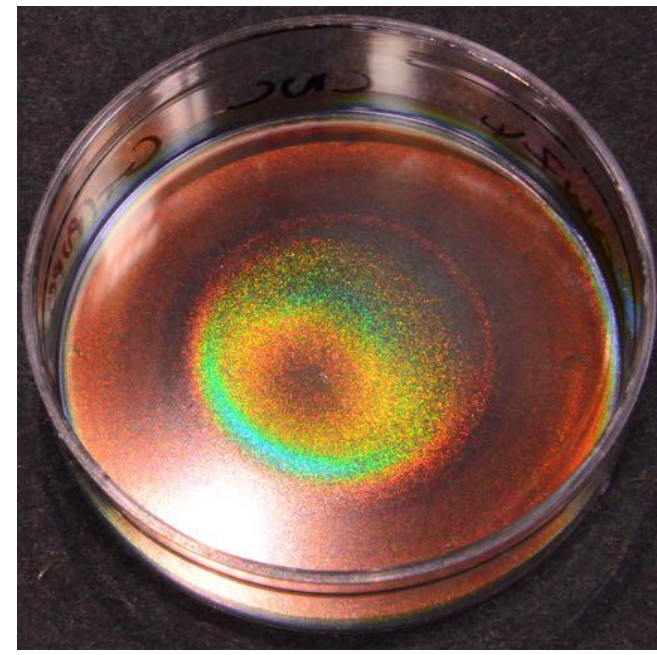
Graphene

- Two-dimensional material
- Very high mobility [2]
- High mechanical strength



Graphene exfoliation with CNC

- Acts as exfoliant and also stabiliser [3]
- Directly applicable of ink printing

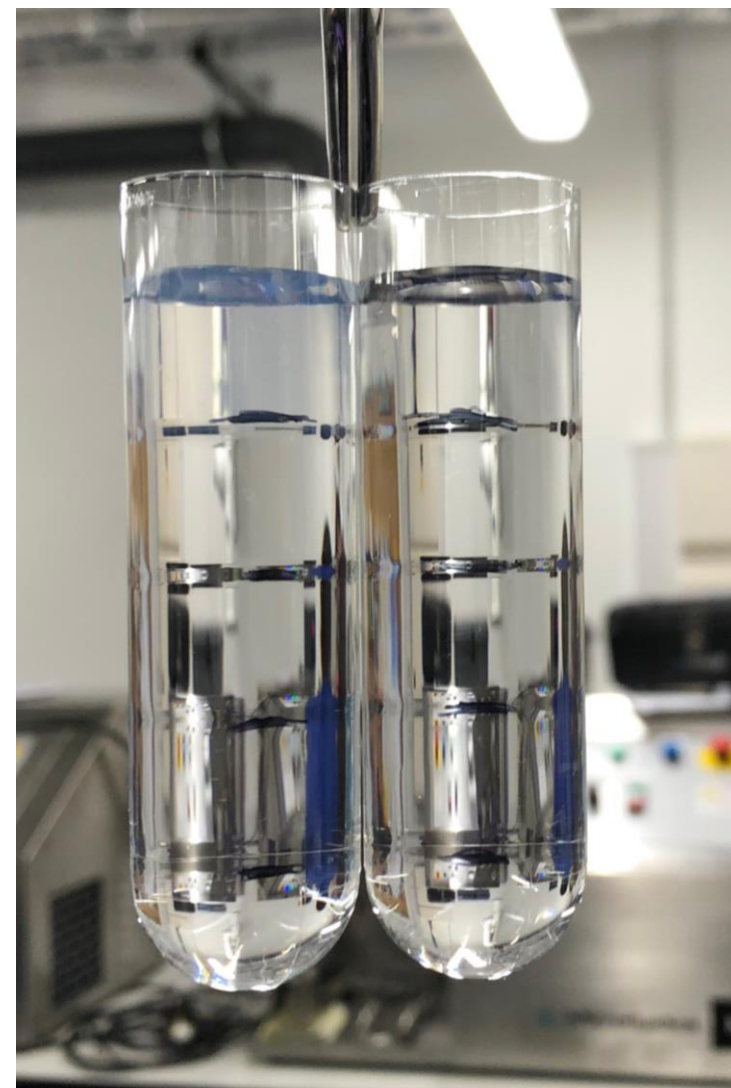
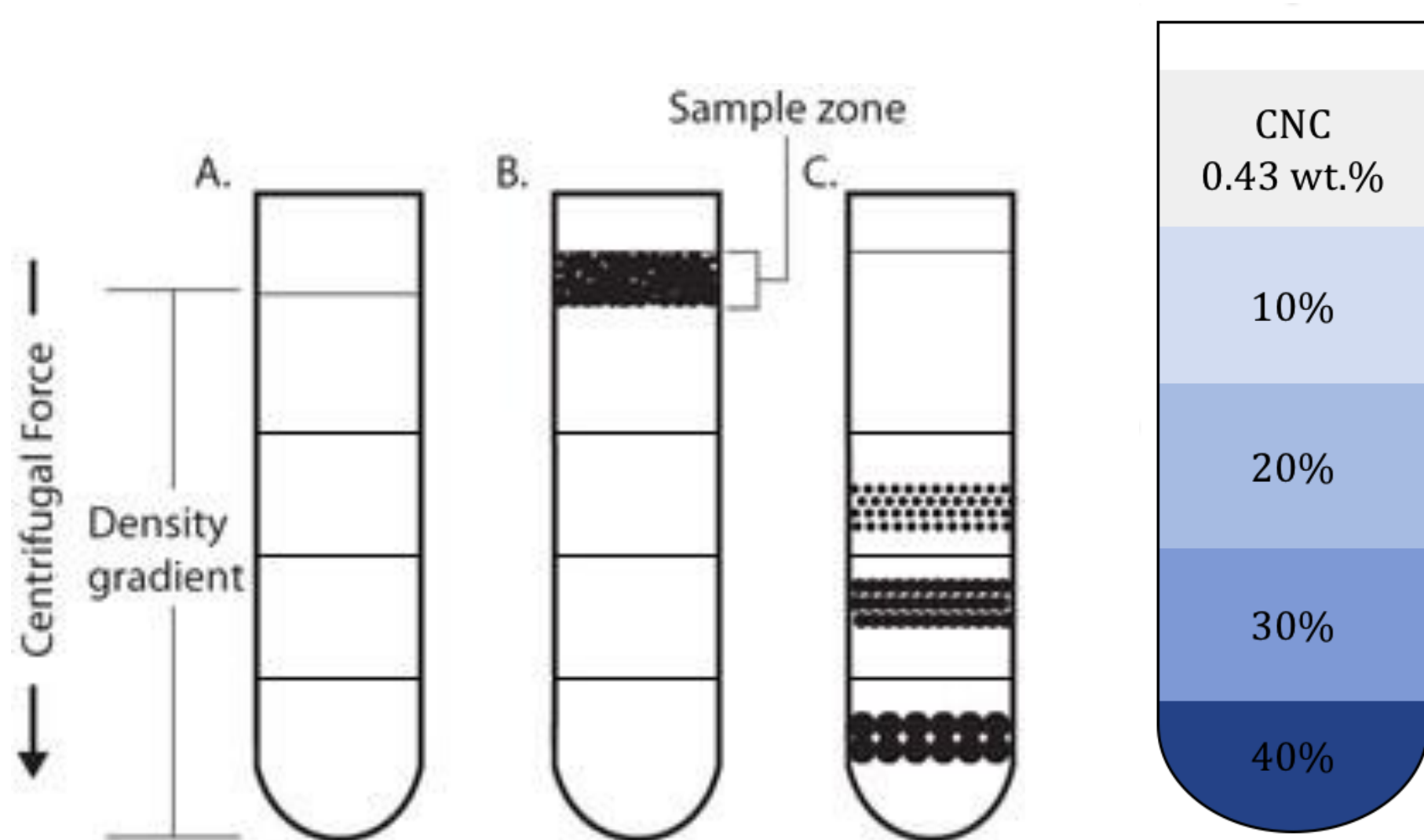


CNC-graphene composite: promising applications

Experimental methods

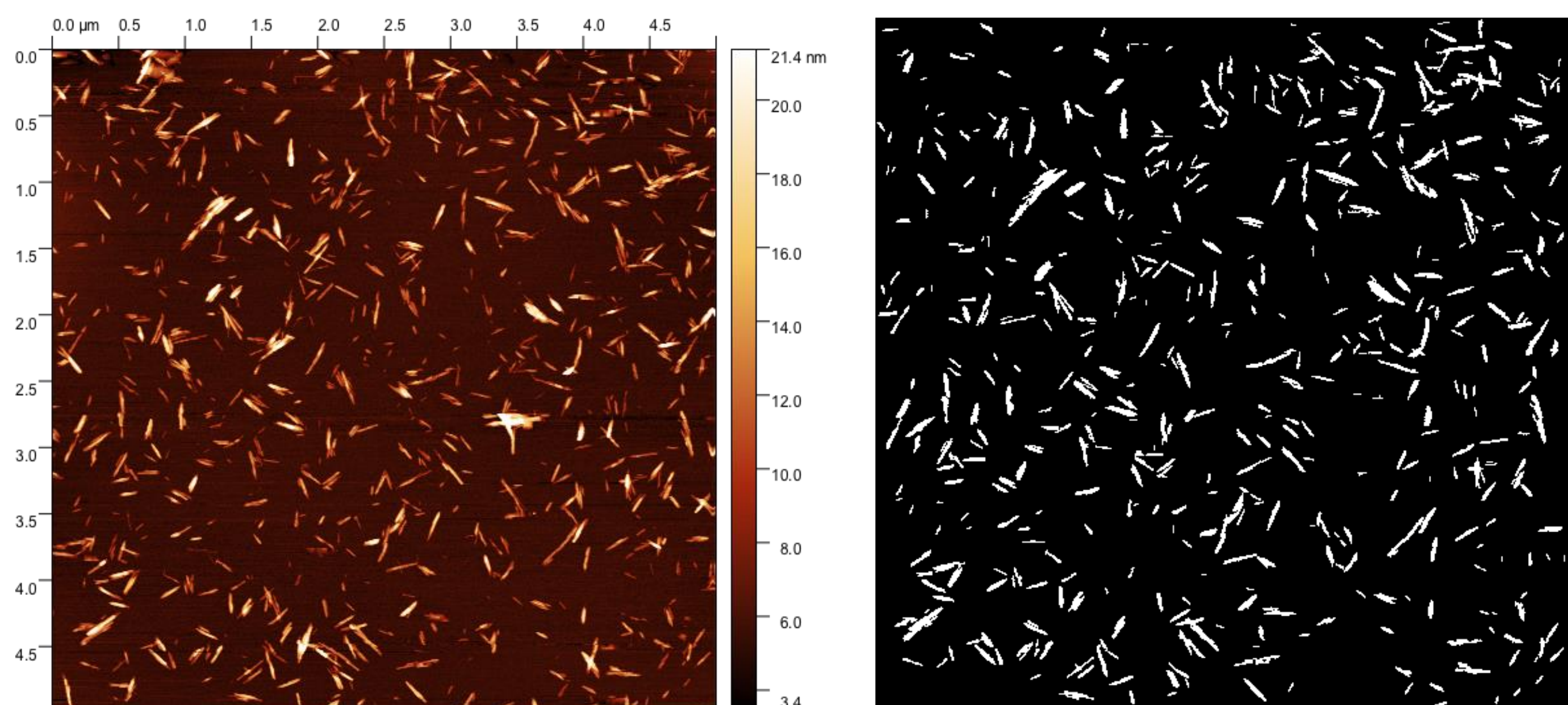
Density gradient ultracentrifugation

- Rate-zonal centrifugation method, separating particles based on viscosity difference in different gradient layers [4]
- Sucrose gradient of 10-40%(m/m)
- Swing-out bucket to keep centrifugal force towards tube bottom
- High speed at 38,430 g, moderate time at 180 minutes



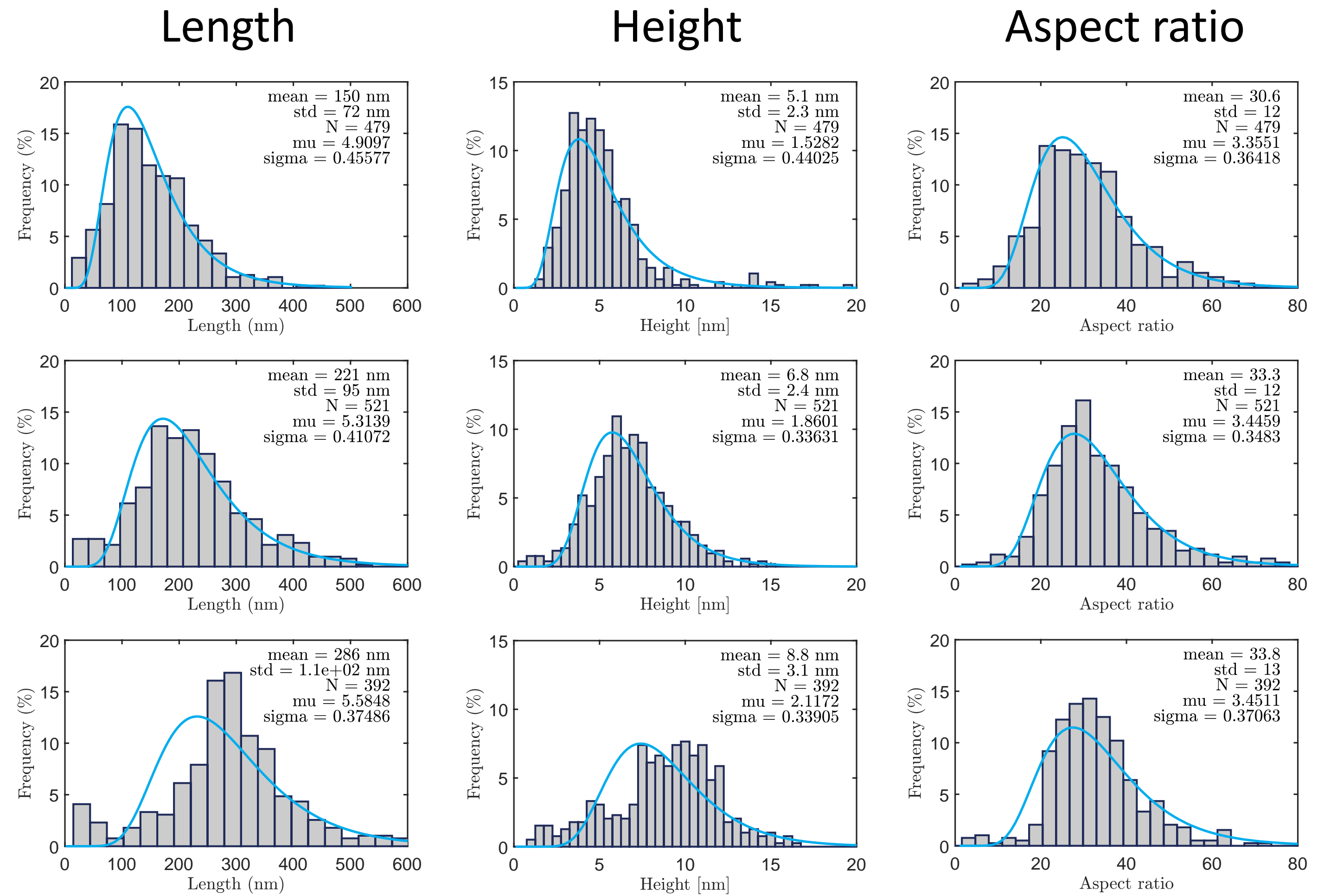
AFM measurement

- CNC fixed on poly-l-lysine treated mica substrate
- Image processing software counts CNC size distribution



Results

CNC size sorting

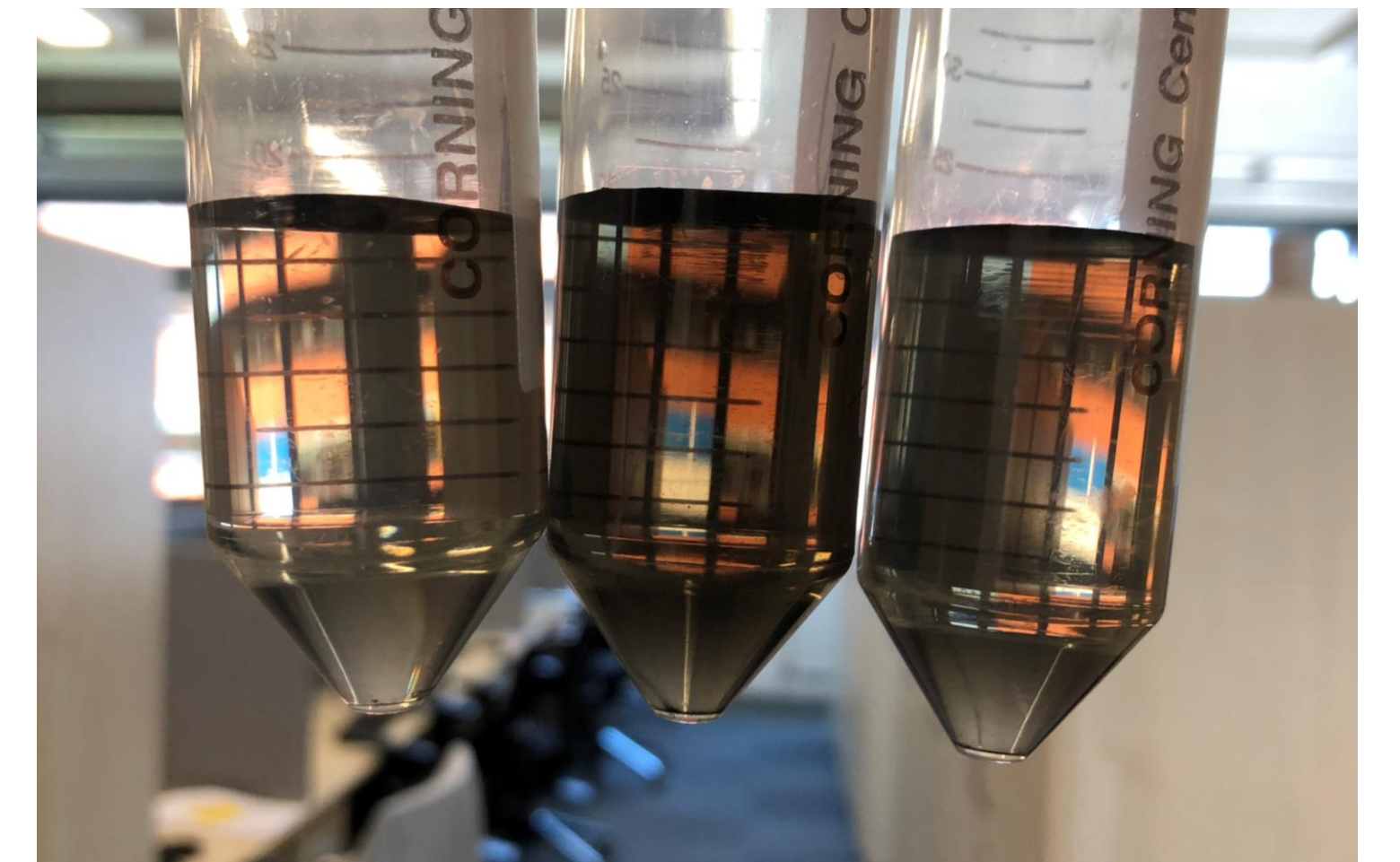


Results show strong correlation between CNC particle size and gradient layer (particle position).

Graphene exfoliation

- Sucrose removed by dialysis [5]; CNC-assisted graphene liquid phase exfoliation for 9 hours [6]
- Concentration measured by UV-Vis:
 - 150 nm CNC – 0.033 g/l
 - 221 nm CNC – 0.045 g/l
 - 286 nm CNC – 0.025 g/l

The correlation between graphene exfoliation yield and CNC size requires higher concentration to further confirm the result.



Conclusion

- CNC size sorting can be achieved via rate-zonal type density gradient ultracentrifugation
- Initial 161 nm (av. length) CNC is fractionated into 150, 221 and 286 nm respectively, with significant difference in yield
- Graphene exfoliation with CNC shows hint of further research
- Future work to be finished involves phase diagram of CNC and improving graphene exfoliation yield with CNC

References

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- [4] M. Frei, *Biofiles*, 6, 17, (2014)
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- [6] F. Bonaccorso, *et al.*, *Opt. Mater. Express*, 4, 63, (2014).

Acknowledgments