実験番号：201905013（2 シフト）

BL8S3

WAXS characterization of raw nanomaterials

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1. Background and research purpose

Graphene oxide membranes have become one of the most interesting nanomaterials that has potential applications in separation technologies.[1] The separation properties of the graphene oxide membranes can be tailored by the addition of a second phase nanomaterial, such as surfactants or few layered graphene sheets, while its adhesive properties can be modified by the introdution of polymers such as polyvinyl alcohol.[2]There is also great interest in combining graphene oxide membranes with the other two dimensional crystalline materials, since nanocomposite membranes might be the future of desalination.[3] Here, we carried out an exploratory research on the mixture of graphene oxide papers with several additives in order to understand its mechanism of drying and formation.

2. Experiment contents

Graphene oxide composite papers were prepared by blade coating a slurry of graphene oxide or slurries of graphene oxide mixtures as previously described.[4] Several additives such as mineral graphite, molybdenum disulfide, boron nitride and carbon nanotubes (CNTs) were added. These inorganic fillers were analyzed by wide angle X-ray scattering in the form of powders. Samples were mounted on aluminum sample holders and observed at the BL8S3 line. The resulting scattering patterns were analyzed using Fit2D software.[5]

3. Results and discussion.

In the current stage of research, we basically characterized the raw materials to be mixed with graphene oxide dispersions in order to prepare hybrid papers. Figure 1 shows the radially integrated wide-angle X-ray scattering patterns of four different inorganic materials: chemically vapor deposited carbon nanotubes (Figure 1a), mineral graphite (Figure 1b), synthetic molybdenum disulfide (Figure 1c), and synthetic boron nitride (Figure 1d). The peaks corresponding to the CNTs are broader than those of the other materials because the interlayer spacings are affected due to the curvature of the carbon nanotubes, as well as the presence of crystalline defects. The other crystalline materials show very sharp peaks characteristic of crystalline materials. In the case of the graphite, individual spots corresponding to the scattering of big single crystal flakes can be clearly seen in the inset, while the molybdenum disulfide and boron nitride show clear rings due to the fine powder form of the sample. Since these materials are two-dimensional, we used the 001 and 002 peaks to calculate the interlayer spacing that match with the reported layered structures. This work is part of the basic characterization of the materials microstructure.

4. Conclusions

The scattering patterns confirm the crystalline structure of these samples. All these materials will be exfoliated with high energy ultrasound to prepare dispersions of nanoribbons (in the case of nanotubes) or nanoplatelets (for the graphite, molybdenum disulfide and boron nitride) before mixing with graphene oxide.

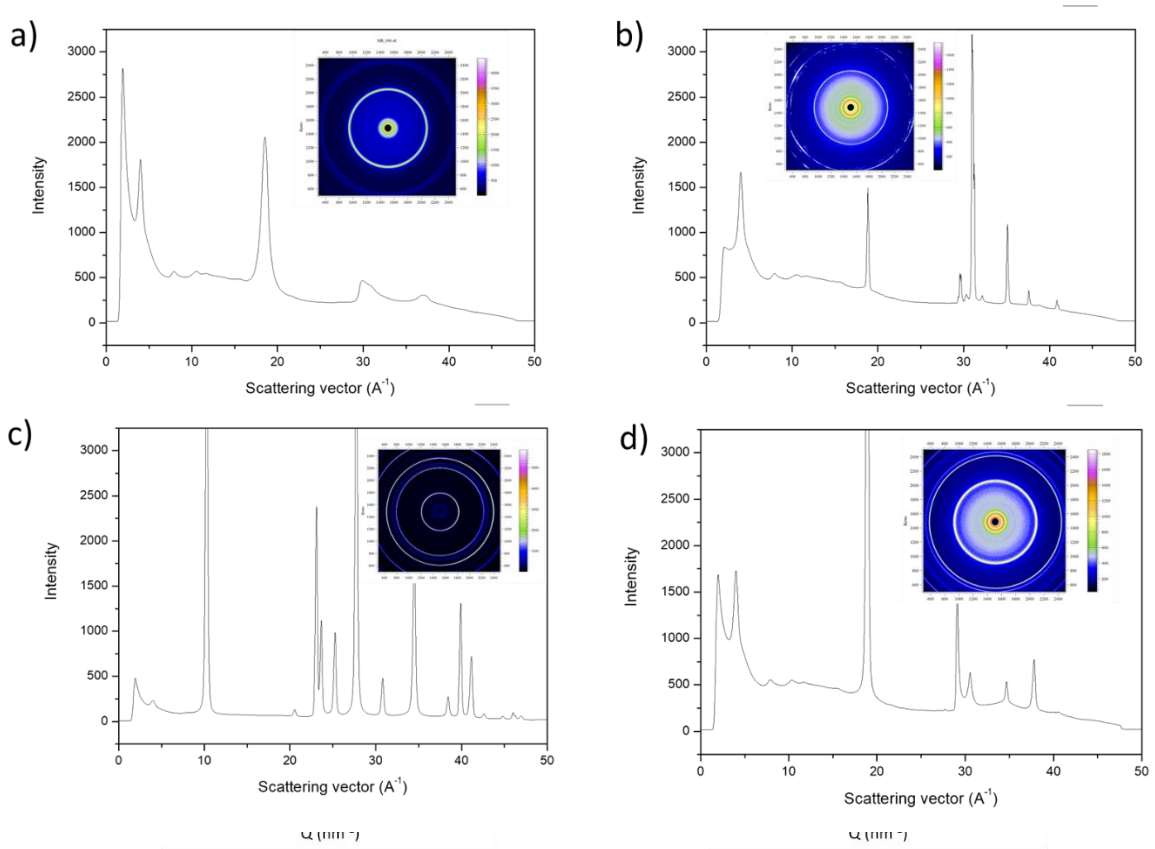

Figure 1. Radially integrated Wide-angle X-ray scattering patterns of a) Carbon nanotubes, b) graphite, c) molybdenum disulfide, and d) boron nitride.

5. References

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