Kazuto Hatakeyama[1, 2]
Yukiya Hakuta[1, 2], Kazuo Terashima[2, 3], Tsuyohito Ito[2, 3], Yoshiki Shimizu[1, 2]
[1]Nanomaterials Research Institute, Department of Materials and Chemistry, National Institute of Advanced Industrial Science and Technology (AIST), 1-1-1 Higashi, Tsukuba 305-8565, Japan.
[2]Advanced Operando-Measurement Technology Open Innovation Laboratory, Department of Materials and Chemistry, National Institute of Advanced Industrial Science and Technology(AIST), 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8589, Japan.
[3]Department of Advanced Materials Science, Graduate School of Frontier Sciences, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8561, Japan.
hatakeyama.kazuto@aist.go.jp

Slide ring material/graphene oxide composite with high mechanical and electrical properties

Stretchable polymer composites are key components of future applications in communication tools, healthcare and robotics. Therefore, an increasing number of research papers regarding stretchable polymer composites have been reported in recent years. Stretchable polymer composites are generally constituted by two main parts; one is a stretchable matrix and another is a functional filler.

Various elastomers have been introduced as matrix to obtain good mechanical property. Recently, slide ring (SR) material has been focused as one of a possible candidate of matrix material. The SR material has polymer chains connected by movable crosslinking bonds and shows extraordinary mechanical properties. One of the most important property is that the high flexibility and toughness are remained even after adding a large amount of filler. Moreover, the robustness of SR material for repetitive stress is sustained because movable crosslinking junctions gives a less stress concentration in a composite. Therefore, SR materials is suitable for matrix of stretchable polymer composites with tough, flexible and desired property. In fact, it has been reported that RS composites using graphene and boron nitride show the good flexibility, high dielectric constant and thermal conductivity.[1, 2]

Carbon materials such as graphite, graphene and CNT have a potential use as filler in stretchable polymer composites because of their good mechanical property, thermal and electrical conductivities, low thermal expansion rate and light weight. Among these carbon materials, we focus on graphene oxide (GO). Unlike other low-dimensional materials, it is possible to get a perfect single-layer GO in large amounts. Therefore, GO has been preferred in batteries, membranes and catalysis which demand a large-scale production, although reduced GO (rGO), the reduced form of GO having a good conductivity, shows less thermal and electrical conductivities than pure graphene and CNT. Recently, we have successfully produced the high stable GO in various organic solvents by easy method and the polyvinyl chloride (PVD)/GO composite with fine structure has been obtained by the technique.[3] Additionally, the PVC/rGO composite prepared using the new method showed better electrical performance compared to a composite prepared using the conventional method. The new dispersion technique can be introduced to a wide range of composites.

In this study, we prepared the RS/GO composite and evaluated its mechanical and electrical properties. The result of tensile test showed that the tensile strength of the SR/GO composite increases until at 8.3 wt.% of GO content while keeping the extension ratio, indicating that the GO filler leads to the enhanced mechanical performance of the composite. Moreover, the SR/GO composite after reduction treatment showed good electrical conductivity (~ 10^{-2} S/cm). We suggest that GO is a good filler material for a SR composite with good mechanical and electrical properties.

References

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