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Molecular orientation study of spacers and membranes by wide angle X-ray scattering.

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1. Background and research purpose

Molecular orientation is a key parameter of polymers that affects not only mechanical properties but also adhesion, fouling, and tribological properties. Our current studies based on molecular dynamics have shown that molecular orientation affects particularly the fouling due to the formation of a flatter surface, and restricted atomic mobility.[1] In the case of membranes prepared with nanotubes or graphene, due to the reduced dimensionality, the orientation effect of the filler usually affects the molecular structure of the matrix. In this work, we are using small and wide x-ray scattering studies to understad the effect of such nanomaterials on the polymer network.

2. Experiment contents

Polyethylene samples reinforced with graphene nanoplatelets (GNP) were prepared by cryomilling followed by molding. These samples were analyzed at the Aichi Synchrotron center in several orientations (See Figure 1) in order to asses effects of the GNPs on the topology of the molecular network. Polyamide and graphene membranes were prepared by interfacial polymerization as reported.[2,3]

3. Results and discussion

The X-ray scattering patterns shown in **Figure 1a** show the plain PE sample oriented perpendicular and parallel to the compression direction. Peaks for the PE(111) and PE(002) are shown in at the left. When we compare with the sample reinforced with GNPs shown in Figure 1b, we can notice the more defined peaks which suggest a higher perfection of the crystals. It the bottom of the radial integration plot, we can see the G(002) peak that indicate the orientation of the graphene nanoplatelets. By comparing the G(002) and the PE(002) peak we can also identify a good correlation between the peaks, that indicates that the GNPs are inducing such changes on the polyethylene crystals. Regarding the polyamide and the graphene membranes, the signals are being currently analyzed, following a similar approach. These results will be obtained shortly.

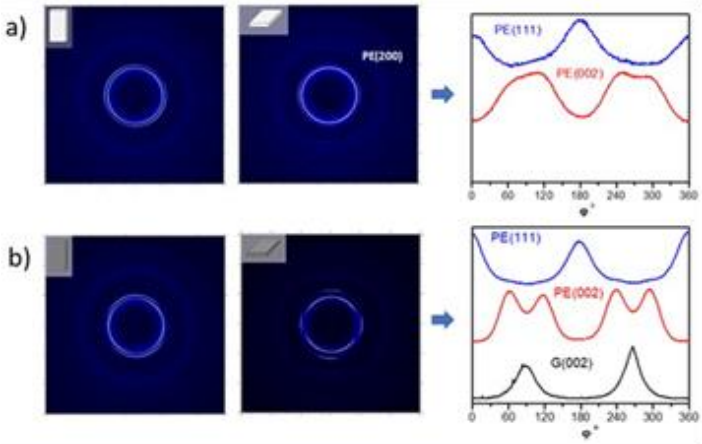

Figure 1. Wide-angle X-ray scattering patterns of the polyethylene/Graphene nanoplatelets composite. a) Plain polyethylene. b) GNP reinforced polyethylene.

4. References

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3. Morelos-Gomez *et al. Nature Nanotechnology* (2017) doi:10.1038/nnano.2017.160