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Limitations of electric field assisted patterning of nanoparticle filled polymers. HILMAR KOERNER, UTC, RICHARD VAIA, WPAFB AFRL, WEI LU, U of Michigan, EVANGELOS MANIAS, Penn State U — Among the many challenges as Polymer Nanocomposites move beyond commodity plastic applications, hierarchical morphology control is paramount as random arrangements of nanoparticles (NPs) will not provide optimized electrical, thermal or optical performance for many potential high-tech applications. Two general approaches to this challenge are emerging, i.e.: external-in (directed patterning of NP dispersions) and internal-out (mesophase assembly of NPs). To better understand limitations of electric field assisted patterning of NPs, the impact of inherent (particle shape, matrix viscosity, complex dielectric properties of the constituents) and external (temperature, frequency and magnitude of applied field) parameters on the torque generated on an isolated NP in a uniform electric field is calculated. An applied electric field induces a dipole in a dielectric particle when it has different permittivity from that of the media. When the particle shape is anisotropic, orientation of the induced dipole does not necessarily coincide with the applied field. The tendency of the dipole to align along the field causes a torque for the particle to rotate. Similarly, conductivity difference of particle and medium causes charges to build up at the interface. This free charge dipole can also generate a torque. These theoretical predictions are compared to experimental observations.

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