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Bound layer in polymer nanocomposites: nanoparticle size dependence and solvent effect NICOLAS JOUAULT, JOSEPH MOLL, DAN ZHAO, SANAT KUMAR, Chemical Engineering, Columbia University — An interfacial polymer layer, or bound layer, has long been of interest in polymer nanocomposites (PNCs) since the divergent properties of the bound layer as compared to the bulk can have very important effects on PNCs properties. We study a system comprised of silica nanoparticles (NPs) in poly-2-vinylpyridine (P2VP) prepared by the solvent casting method. First, we determine by TGA the bound layer thickness δ in PNCs and show that *i)* δ decreases as NP radius decreases due to a decrease of polymer adsorbed amount and *ii)* δ scales as $N^{1/2}$, where N is the chain length, independent of NP size. This result qualitatively follows the theoretical prediction in term of loops distribution developed by Guiselin et al. for a flat surface. Here we note that the bound layer thickness is obtained by assuming that the polymer chains have a density corresponding to a dense melt – this is clearly not a well-founded argument, and hence we measure a more realistic extent of the bound layer by using Dynamic Light Scattering in solution. Then, we investigate the influence of the solvent used to prepare the PNCs (in our case methylethylketone (MEK) or pyridine) on the bound layer and the final silica dispersion in PNCs. We show that pyridine prevents the P2VP adsorption leading to poor silica dispersion in the final PNCs while in MEK the good dispersion is related to the formation of a bound layer.

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