Polymer nanocomposites are a new class of multiphase materials containing dispersed nanoparticles. They can have significantly improved physical and mechanical properties by inclusion of a small amount of nanoparticles relative to the native polymers.

The challenge is to develop the precise control of the dispersions of nanoparticles in polymeric based nanomaterials.

Researchers have discovered a simple, low-temperature, robust route to control spatial distributions of surface-modified nanoparticles in polymer thin films by using supercritical carbon dioxide (scCO\textsubscript{2}) as a “green” processing agent.

By “tuning” the CO\textsubscript{2} environmental conditions and film thickness, they can make the nanoparticles switch the spatial arrangements between preferential surface segregation at the polymer/air interface and homogenous dispersion within the entire film.

The resultant structures in CO\textsubscript{2} can then be solidified by a combination of vitrification and cross-linking of the polymer matrices to achieve its sufficient thermal stability.

Structural characterization used the complementary techniques of x-ray reflectivity at NSLS beamline X10B and neutron reflectivity at the NIST Center for Neutron Research.