Characterization of Magnetic Dispersions Prepared With Polyurethane Binders

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Objectives

• Compare the dispersion quality of PU polymers with PVC polymers in magnetic inks
• Characterize interactions between PU polymers and magnetic particles
• Investigate microstructure of magnetic inks dispersed with PU polymers
• Improve the PU polymer as a binder in magnetic dispersions
Sample Preparation

Materials:
• Binder: PU1(Mn=10000), PU2(Mn=20000), PVC1(Mn=10000) and PVC2(Mn =20000)
• Solvents: Cyclohexanone/Toluene (7/ 3)
• Magnetic particles: Metal Particles (MP)

Dispersion process:
• Mixed by DPM 3hrs (6g binder + 36g MP + 18g cyclohexanone + 4.2g toluene) Dough
• Dispersed by stirring 3hrs (Dough + 50.6g cyclohexanone + 22g toluene) Preliminary dispersion
• Eiger milled 2hrs (preliminary dispersion + 3.2g toluene) Final dispersion
From the strain sweep test, the critical strain at which the structure is broken is similar for PU2 and PVC2, but it is very low for PU1, which implies there is a very weak - or even no - structure in it.
PVC2 and PVC1 show an independence of frequency, which means there is a structure behaving like a solid. PU1 and PU2 show more liquid like behavior with an obvious dependence on frequency.
PU2 and PVC2 have relatively high viscosity. PVC1 and PU1 have such a low viscosity that at low shear rate, it cannot be measured with this rheometer.
The magnitudes of transverse susceptibility for PU1 and PU2 inks are higher, which indicates there are more individual particles or smaller aggregates than in PVC inks.
TEM Image of PVC2 Ink

This is the TEM picture of MP particles used here dispersed with PVC2 polymer. A typical network structure is evident.
Conclusions

• PU polymers have better dispersion quality than PVC polymers applied here.
• High MW polymers PU2 and PVC2 dispersed magnetic inks have strong structures, which may be network structures.
• Although PU1 has low MW indicating the molecules may be not long enough to provide a good steric barrier, it shows a good dispersion quality according to magnetic measurements.