Search for Order in MP Dispersion: Cryo VSM

B. He, J.M. Wiest, D.E. Nikles

MINT Center and Department of Chemical Engineering
The University of Alabama

Purpose
- Examine particle orientation in magnetic dispersions
- Determine order parameter $S$ by using experimental method: VSM
- Understand the contribution of particle orientation to the overall physical properties of the tape
- Explore effects of: particles, binder, order

Order Tensor & Parameter

\[
S = \left( uu - \frac{1}{3} \delta \right)
\]

How to get $S$
- Measure the angular dependence of the magnetic remanence by using VSM: Vibrating Sample Magnetometer
- Determine the distribution of particle orientation directions
- Extract values of the order parameter, $S$

Angular Dependence of Remanence

- Apply a magnetic field on the MP dispersions, then freeze the dispersions while holding the magnetic field
- Saturate with an applied field of 12,000 Oe and measure the saturation magnetization, $M_s$
- Set the applied field to zero and measure the remanent magnetization in the direction parallel to the applied field, $M_p$
- Repeat at 5° increments to obtain curves of $M_s(\theta)$, $M_p(\theta)$ and $M_t(\theta)$ from 0 to 180°

Distribution of Particle Orientations

- $M_p$ is the remanence measured parallel to the applied field
- $M_t$ is the remanence measured transverse to the applied field

Optimal polymer binder concentration

- Polymer binder plays an important role in magnetic dispersions
- The maximum $S$ indicates the optimal polymer binder concentration

Order Parameter vs. Applied Field

- $S$ increasing with applied magnetic field indicates more and more particle network structure is broken and aligned in the direction of the applied external magnetic field.

Conclusion and future work
- A new technique has been successfully developed to determine the particle order in magnetic dispersions
- The effects of polymer binder have been investigated
- Particle order in magnetic dispersions is a function of applied external field
- In the future we will continue to explore the order parameter $S$ in magnetic dispersions.

For more information and reprints contact:
Dept. of Chemical Engineering, MINT Center
E-mail: he003@bama.ua.edu