CHAPTER V

CONCLUSIONS

Poly(p-benzamide) (PBA) was synthesized by the direct polycondenzation of p-aminobenzoic acid (p-ABA). From spectroscopic characterization and molecular weight determination, PBA specimens were successfully synthesized to yield different molecular weights by changing the type of solvent and metal halide, and the amount of the phosphorus compound used. Changing the amount of solvent and the reaction time did not affect the molecular weight. In summary, the three different materials obtained, designated PBA-1; PBA-9 and PBA-2, have M_w = 3,900; 8,600 and 11,000 g/mol, respectively. PBA are thermally stable up to approximately 500^0C. Higher molecular weight PBA has higher thermal stability. The decomposition temperature (T_d) of PBA is at around 575^0C. T_d increases slightly with molecular weight. PBA-1 and PBA-2 form nematic LC phases in 4%LiCl/DMAc and 4%LiCl/NMP solvents at 25^0C at very low concentration compared to other lyotropic LC polymers. The higher the molecular weight polymer, the easier the LC phase is formed. Thus, the isotropic-nematic transition of PBA-2 occurs at a lower concentration than PBA-1. PBA solution in 4%LiCL/NMP, for each molecular weight, forms LC phase at lower concentration. This is believed due to the large pendant positive group in LiCl/NMP solvent system. PBA shows an ER effect both in the LC state and as a particle dispersion. Unfortunately, the modified cone and plate attachment was destroyed during ER studies in the LC state due to electrolytic reaction. Thus PBA was investigated as anhydrous particle dispersion type ER fluids. The magnitude of the observed ER effect was comparable to that for anhydrous polianiline dispersion, presumably because the conductivity of PBA is close to that of polyaniline commonly. In addition, the particle size of

PBA is easily prepared to be monodisperse distribution and the shape of PBA-1 is nearly spherical even without ball-milling. The PBA ER fluid samples show linear viscoelastic behavior at a small strain amplitudes, indicating mimimal deformation of the chain-like solid-induced structure. The response time to the external electric field of 2 kV/mm is approximately 30 s. The storage modulus (G') and the loss modulus (G'') increase with increasing electric field strength, due to the stronger electrostatic force between the particles in the chains. In the linear viscoelastic regime, at the electric field strengths of 0, 0.02 and 0.25 kV/mm, the ER sample behave as a viscous fluid in that G'' is much higher than G' over the entire range of frequency. In contrast, at the electric field strengths of 2 kV/mm, G' is larger than G'' over the entire range of frequency. Thus this suspension behaves as a solid under this electric field strength. For the electric field strengths of 0.4, 0.5 and 1 kV/mm, G' is higher than that of G'' at low frequency. Again, this indicates an elastic response determined by the particle chain structures form in the imposed electric field. These field-induced structure are viscoelastic in that a predominantly elastic response observed at low deformation sequence, but at higher frequencies particle motion produces a more viscous response. In the linear viscoelastic region, there is a critical electric field strength for the transition from liquid to solid state. In the nonlinear viscoelastic regime, at 600 %strain, the viscous contribution to the total dynamic response is dominant, and only the loss modulus can be measured. Further, the ER effect in the nonlinear viscoelastic regime is smaller than that in the linear viscoelastic regime, due to the large deformation of the chain structures.