Phase Behavior of Ternary Mixtures Containing High Energy Materials (HMX and RDX), Organic Solvent and Supercritical Carbon Dioxide

Joon-Yong Ahn and Byung-Chul Lee [C, S]
Department of Chemical Engineering, Hannam University, Daejeon, Korea

Youn-Woo Lee
School of Chemical and Biological Engineering, Seoul National University, Seoul, Korea

Hyoun-Soo Kim
Agency for Defense Development, Daejeon, Korea

Supercritical fluid processes have gained great attention as a new and environmentally-benign method of preparing the microparticles of high energy materials like explosives and propellants. In order to develop a process of recrystallizing high energy materials by utilizing supercritical carbon dioxide as an antisolvent, it is important to know the location of the phase boundaries in the mixture solutions of high energy materials, supercritical carbon dioxide, and an organic solvent. In this work, HMX (cyclotetramethylenetetranitramine) and RDX (cyclotrimethylenetri- nitramine), which has been being widely used as high explosives not only for military purposes but also in industrial applications, were selected as target high energy materials. The organic solvents used in this work were acetone, cyclohexanone, and 1-methyl-2-pyrrolidone. The phase boundaries between single-phase and two-phase for the ternary mixtures containing high energy material, carbon dioxide and organic solvent at three different pressures of 10 MPa, 15 MPa, and 20 MPa were determined by measuring the cloud point temperatures as a function of the mixture composition using a high-pressure equilibrium apparatus equipped with a variable-volume view cell. At a fixed pressure and temperature, as the composition of carbon dioxide in the ternary mixture increased, the two-phase region enlarged. Addition of carbon dioxide anti-solvent to the mixture caused a decrease of the dissolving power of the mixed solvent for the high energy material. The two-phase region also enlarged as the amount of the high energy material in the ternary mixture increased.