**Introduction and Overview**

New synthetic routes for the preparation of magnetic nanoparticles and thin films are under constant investigation. In particular iron oxide magnetic particles have attracted interest due to their application as recording media, ferrofluids, catalysts and targeted drug delivery. Ferric acetylacetonate Fe(acac)₃ is known to undergo thermal decomposition to form either Fe₃O₄ or γ-Fe₂O₃ magnetically ordered materials when heated above 130 °C. We decompressed a mixture of ferric acetylacetonate (Fe(acac)₃) in supercritical CO₂ to deposit magnetic nanoparticle films at room temperature. Two different processes were developed: one based on the Rapid Expansion of a Supercritical Solution (RESS) and another based on the depressurization of the saturated supercritical mixture in a fixed volume (BATCH process). The rate of decomposition varies dramatically between the two processes, RESS (sec scale) and BATCH (min scale).

**Supercritical Fluid**

A fluid above its critical point

- CO₂: Tₚ = 31.1 °C, Pₚ = 73.8 bar
- Single phase with properties of both a liquid and a gas
- Ability to dissolve low vapor pressure solids at high pressures but modest temperatures
- Applications include decaffeination of coffee, toxic waste combustion, dry cleaning, particle and thin film formation

**Ferric Acetylacetonate (Fe(acac)₃)**

**RESS Experimental Apparatus**

The magnetic thin films are produced by expanding the supercritical solution and directing the resulting supersonic jet onto cold silicon wafers.

**BATCH Experimental Apparatus**

Depressurization of the supercritical mixture within the fixed volume UV-VIS cell causes the solute to precipitate and deposit on a silicon wafer, placed within the cell.

**Results: Magnetic Measurements**

- **RESS process**
  - Pb = 1 atm/Na₂O
  - Size: 30-100 nm
  - Pb = 1 atm/air
  - Size: 100-700 nm
- **BATCH process**
  - Pb = 10 Torr
  - Size: 80-600 nm

**Ferromagnetic** signal with similar properties at 2K and 300K for both RESS and BATCH processes

**Comparable paramagnetic** signal strengths only for RESS samples

- At 300K: Mₛ=7.3x10⁻⁵ emu, Hₑ=35 Oe, M_r=2.1x10⁻⁶ emu (BATCH)
- At 300K: Mₛ=1.4x10⁻⁵ emu, Hₑ=55 Oe, M_r=8.3x10⁻⁶ emu (RESS)

**Fe(acac)₃** starting material is paramagnetic

**Calculated Centerline Properties of CO₂/Fe(acac)₃, RESS Expansion**

Pₚ = 140 bar, Tₑ = 313K

Xₛ = 1.4x10⁻⁶ mole fraction

Since the RESS expansion is predicted to provide less than 10 nm scale clusters, substantial growth must occur at the surface

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