V. CONCLUSIONS AND RECOMMENDATIONS

The high-pressure research studies conducted under this program have been four varieties: Densification of oxides; synthesis of new materials; compressibility measurements, and sound velocity measurements.

The densification studies have shown that completely dense transparent oxides with extremely fine grain size can be prepared at relatively low temperature under ultrahigh pressure.[34, 35, 36] Along with the fine grain size, high hardness values have been obtained,[37] e.g., the hardness of magnesium oxide produced by these techniques was twice that of single crystals of the same oxide and 30 to 50 percent greater than that of hot-pressed material. The processing variables have been studied and optimum conditions found. A series of samples have been prepared and submitted to the Air Force Cambridge Laboratories for further study, in-house, of the relations between hardness and other physical properties. Similar studies of the densification at ultrahigh pressure may lead to improved values of other properties e.g., magnetic permeability or coercive force, or dielectric permittivity or coercive force in appropriate materials. Such studies proposed earlier, but deferred in favor of others should be resumed now.

In experiments with the high-pressure apparatus, the synthesis of the high-pressure modifications of boron nitride (cubic BN) and silica (Coesite) have been duplicated. In addition in studies of the rare earths, a new form of the oxyhydroxide of samarium has been dixcovered and characterized.[38] The systematic study of the oxides and oxyhydroxides of only the rare earth elements would constitute an extensive program of itself. No recommendations are made at this time for continued work along these lines.

X-ray diffraction studies have been performed in a camera in which the high pressure is achieved between diamond anvils. This camera is best suited to the study of phase transformation at high pressure. It has been used for the measurement of the compressibility of the high-pressure modification of alkali halides above their transition pressures. Results have been obtained for the high-pressure forms (cesium chloride structure) of rubidium bromide and rubidium chloride.[39] These studies of compressibility should be continued. In addition, studies of phase transformation *per se* in compounds of interest to the Electronic Material Sciences Laboratory should be undertaken.

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