At high pressures (greater than 30 kilobars) nearly complete densification of oxide powders is achieved at much lower temperature and in shorter time than is otherwise required. Under these conditions, dense material with a very fine grain size is obtained. A good example of the microstructure studies is afforded by our investigations of the properties of MgO formed at high pressures. Electronic grade MgO with an initial particle size of 300 Å (from x-ray line broadening measurements) or 500 Å (from electron microscopic examination) was densified at pressures of 12.5 kilobars and above and temperatures between 500 and 1000°C. At 12.5 kilobars and 900°C, essentially complete densification was achieved in 5 to 10 minutes. The material was transparent in 1/16 inch sections. Electron micrographic examination showed a grain size in the submicron range (approximately ~~0.5~~ 0.05 micron, 500 angstroms) as shown in Figure 2. X-ray diffraction line broadening showed an apparent grain size of about 500 Å indicating considerably strain. The Knoop hardness of this material was about 1200 Kg/mm^2 under a 100 gram load as compared with 600 for single crystal MgO and 800-900 Kg/mm^2 for hot pressed MgO.

Although the development of improved properties by ultrahigh pressure forming could be discussed at more length, I want to go on to other studies at this time.

The rare earths, that is the sesquioxides, are found in three distinct structural forms. The first of these is the hexagonal or A-R_2O_3 structure which is typified by La_2O_3. The second is the monoclinic or B-R_2O_3 structure and the third is the cubic or C-R_2O_3 structure which is the same as that of Mn_2O_3. In general, the rare earth metal ions with the largest radii; e.g., lanthanum, form the hexagonal oxide, and those with the smallest radii form the cubic oxide. Many of the rare earths can be obtained in two modifications. Thus, samarium oxide is found in both the cubic - C and monoclinic - B forms.