X-ray photoelectron spectroscopy and Fourier transform–infrared studies of transition metal phosphate glasses

E. E. KHAWAJA, S. M. A. DURRANI, F. F. AL-ADEL, M. A. SALIM*, M. SAKHAWAT HUSSAIN ‡

*Energy Research Laboratory, Research Institute, *Department of Physics, and ‡Department of Chemistry, King Fahd University of Petroleum and Minerals, Dhahran 31261, Saudi Arabia*

X-ray photoelectron spectroscopy and Fourier transform–infrared studies were carried out on phosphate glasses containing oxides of iron, cobalt, nickel, copper and zinc. The results suggest that the glasses containing iron and zinc may have structures in which both the phosphorus and the iron (or zinc) atoms are tetrahedrally coordinated by oxygen into three-dimensional structures which resemble the polymorphic forms of silica, whereas the glasses containing cobalt, nickel and copper may consist of polymeric chains of PO_4 tetrahedra bonded to adjacent tetrahedra via bridging oxygens. These polyphosphate chains are linked together by the interaction between the metal cation and the oxygens of the network former. In addition, the core level 2p shake-up satellites of the 3d-transition metal ions in these glasses were studied. The results support a suggestion that the satellites in the glass are most likely due to the electron transfer from ligand to metal 3d orbitals.