Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

**Defect Diffusion, Free Volume and Positron Annihilation Spectroscopy** MICHAEL SHLESINGER, Office of Naval Research, JOHN BENDLER, JOHN FONTANELLA, Physics Dept., US Naval Academy, J. BARTOS[1], Polymer Institute of SAS, O. SAUSA, J. KRISTIAK[2], Institue of Physics of SAS — Employing an anomalous defect diffusion theory that was devised to explain stretched exponential relaxation and the accompanying Vogel type law, a new theory of free volume in glasses and glass-forming liquids is developed assuming a temperature/pressure dependent population of mobile single defects and immobile defects clusters. The defects encapsulate free volume and a defect cluster is found to possess less free volume than its separated constituent defect parts. The theory is applied to free volumes obtained from positron annihilation lifetime spectroscopy (PALS) studies of poly(propylene glycol) (PPG) 4000 over the wide temperature range from 15 K to 320 K and gives a good description of the free volume vs. temperature. The theory also reasonably predicts the variation of the ortho-positronium (o-Ps) intensity.

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Date submitted: 24 Nov 2004 Electronic form version 1.4