明志科技大學 100 學年度研究所碩士班一般考試暨在職專班招生命題用紙

所別： 材料工程研究所 組別： _____ 科目： 物理冶金

注意：□不准□一般計算器■工程用計算器，考試時間總計：100 分鐘。試題共 2 頁，第 1 頁

(1) There are three slip systems on a fcc (111) plane. Assume a 1.8 MPa tensile stress is applied along the [100] direction of a gold crystal, whose critical resolved shear stress is 0.91 MPa. Please determine (a) three slip systems and (b) verify that measureable slip will not occur on any of three slip systems in the (111) plane as a result of this applied stress. (15%)

(2) (a)Please write down the Hall-Petch equation and identify the physical meaning of each term. (b) Why a much lower applied stress is required to cause slip to pass through the grain boundary in coarse-grained materials than in the case with fine-grained materials? (15%)

(3) A diffusion couple was made by welding a thin one-centimeter square slab of pure metal A to a similar slab of pure metal B and diffusion annealed at an elevated temperature and then cooled to room temperature. On chemically analyzing successive layers of the specimen, cut parallel to the weld interface, it was observed that, at one position, over a distance of 8000 nm, the atom fraction of metal A, N_A, changed from 0.30 to 0.45. Assume that the number of atoms per m^3 if both pure metal is 8 x 10^{28}, Please determine the (a) concentration gradient dn_A/dx and (b) the number of A atoms pass through this cross-section per second at the annealing temperature, assuming the diffusion coefficient at the point of diffusion and the annealing temperature was 2 x 10^{-14} m^2/s. (15%)

(4) In a scanning electron microscopy (SEM), we can observe the surface morphology of a specimen by secondary electron image (SEI) and backscattered electron image (BEI), respectively. Please explain (a) what are the secondary electrons and backscattered electrons in a SEM and (b) what features these two images can provide. (15%)

(5) Please explain briefly the mechanism of precipitation hardening. (15%)

(6) Please discuss the microstructure and property changes in the annealing treatment of a heavily cold-rolled metal. (15%)

(7) A 111 standard stereographic projection of a fcc crystal is shown below. Assuming that point A in this figure represents the orientation of the tensile stress axis, please (a) draw the path that the

crystal axis would follow during tensile deformation of the crystal and (b) give the Miller indices of the final orientation of the stress axis. (10%)