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purpose: the aim of this study was to compare the mechanical properties of an anterior cruciate ligament (acl) substitute made from a blend of chitosan-derived biomaterials and polyacrylic acid with that of a traditionally developed composite obtained by soaking an acellularized rat collagen membrane in a polyacrylic acid solution. design: seventy four nondestructive mechanical tests (nmt) were performed on 12 specimens obtained from the anterior cruciate ligament (acl) substitute made from a blend of a chitosan-derived biomaterials and polyacrylic acid (0.2% w/w of polyacrylic acid solution) and the traditional composite (0.9% w/w of polyacrylic acid solution). the biostability of these constructs was assessed by mechanical tests for implantation in nude rats (5 animals per group) for 16 weeks. methods: nondestructive mechanical tests were performed on micro-uniaxial tension (ut) and compression (uc) (n = 12) tests on a thermomechanically cycled and load-transmitting (ut/uc) machine. the full body of these specimens was submitted to the nmt; these included 1) a stability measurement in a lateral tibial loading direction and 2) a measurement of the stiffness and strain energy absorption of the cylindrical specimen portion. nanocrystalline powders are considered to be ideal carriers for drug delivery. however, the issue of low drug loading (dl) percentage in the nanocrystalline powders is one of the most important challenges for the drug delivery system. we introduce a nano-emulsion method to synthesize a nanocrystalline powder. the obtained nanocrystalline powders were characterized by x-ray diffraction (xrd), fourier-transform infrared spectroscopy (ft-ir), differential scanning calorimetry (dsc), scanning electron microscopy (sem), and brunauer-emmett-teller (bet) method. we employed the nano-emulsion method to synthesize the nanocrystalline powder containing isoniazid (inh). the dl of the nanocrystalline powder was determined by using uv-vis spectrophotometer and diffused reflectance infrared fourier transform spectroscopy (drifts). the results showed that the dl of the nanocrystalline powders was above 80%. when the dl of the nanocrystalline powder was as high as 80%, inh was released slowly from the nanocrystalline powder. the cellular uptake and in vitro drug release of the nanocrystalline powder were also investigated. the results showed that the cellular uptake and drug release could be manipulated by varying the quantities of nanocrystalline powders.

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the properties of multicomponent alloys have been studied by ab initio simulations. phase diagrams, elastic constants, lattice vibrations, and defects for the fe-al-cr alloy system were investigated with accurate density-functional theory (dft) calculations and compared with experimental results. the results from dft show good agreement with results from liquid-state experimental measurements. the elastic constants and debye temperature of two-component alloys and their sub-alloys were obtained from the dft calculations. it is concluded that the defect parameters are sensitive to the alloy component concentrations but only weakly dependent on each other. regarding alloy systems with a large number of components, dft calculations are more efficient than conventional methods. the ab initio calculations of an ag-ag-cu alloy system with multicomponent structure have been carried out, showing that the computational efficiency of the ab initio method is excellent for analysis of the large number of degrees of freedom of alloy systems with multicomponent structures. the structural instability and aggregation behavior of amorphous glass-forming polymer chains under rapid quenching from melt state to low temperature has been studied by molecular dynamics simulation. the results show that the glass transition mainly relates to the motion and structural changes of amorphous chains. the slip and vacancy dynamics of amorphous chains are different from those of crystalline polymer. the hexagonal order of amorphous chains are also discussed. the analysis of the relation between the long-time structural information and glass transition reveals that the glass transition are caused by the maximum of potential of the glassy state. and the total potential surface has two minimums at small and large distance of the atomic position. the larger local structure changes correspond to the larger potential barrier height and the higher free energy barrier in the atomic mobility process. the molecular-dynamics simulation of atomic motion in glass-forming polymer chains is a promising method for analysis of glass transition, and this method is widely used in materials science. 5ec8ef588b