Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Nano-Engineered Cubic Zirconia for Orthopaedic Implant Applications[1] F. NAMAVAR, University of Nebraska Medical Center, A. RUBINSTEIN, University of Nebraska at Omaha, R. SABIRIANOV, UNO, G. THIELE, J. SHARP, U. POKHAREL, R. NAMAVAR, K. GARVIN, UNMC — Osseointegration failure of the prosthesis prevents long-term stability, which contributes to pain, implant loosening, and infection that usually necessitates revision surgery. Cell attachment and spreading in vitro is generally mediated by adhesive proteins such as fibronectin and vitronectin. We designed and produced pure cubic zirconia (ZrO2) ceramic coatings by ion beam assisted deposition (IBAD) with nanostructures comparable to the size of proteins. Our ceramic coatings exhibit high hardness and a zero contact angle with serum. In contrast to Hydroxyapatite (HA), nano-engineered zirconia films possess excellent adhesion to all orthopaedic materials. Adhesion and proliferation experiments were performed with a bona fide mesenchymal stromal cells cell line (OMA-AD). Our experimental results indicated that nano-engineered cubic zirconia is superior in supporting growth, adhesion, and proliferation. We performed a comparative analysis of adsorption energies of the FN fragment using quantum mechanical calculations and Monte Carlo simulation on both types of surfaces: smooth and nanostructured. We have found that the initial FN fragment adsorbs significantly stronger on the nanostructured surface than on the smooth surface.

[1]This work was supported by the Department of Energy

Fereydoon Namavar
University of Nebraska Medical Center

Date submitted: 15 Dec 2011 Electronic form version 1.4