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Characterization of Biodegradable/Bioresorbable Polymer Scaffolds for Osteoblast Cell Growth by SEM and TEM

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Interest in the development of biodegradable/bioresorbable material for use in tissue engineering has grown significantly over the past decade. These new biodegradable/bioresorbable materials would be especially useful for the redevelopment of bone tissue in areas where bone has been extracted or destroyed. The purpose of this project is to develop biodegradable/bioresorbable polymer scaffolding for the reproduction and regrowth of bone tissue. The scaffolding can then be characterized by SEM and TEM. Following the bone cell growth in vitro, the SEM can again be utilized to determine the extent of penetration and cell viability withinthe scaffolding.

The scaffolding specimens were formed by two different techniques. The first technique involved mixing a biodegradable/bioresorbable polymer with a ceramic powder. The polymer/ceramic blend was then mixed with a water extractable material of various particle sizes. The formulations were then compression molded. Following the compression molding, the particles were extracted with de-ionized water yielding scaffolds of various pore sizes. The second technique involved electrospinning. Three different scaffolding specimens were formed with electrospinning; the first used only the polymer, the second was of the polymer/ceramic blend, and the third was formed with hyaluronic acid. All of the scaffolds were then seeded with osteoblast cells in vitro. The major variables in the process were; pore size (compression molded samples only), percentage of ceramic blended with the polymer, effect on cell growth between the polymeric scaffolding and the hyaluronic acid scaffolding, and the effect on cell growth between the compression molded scaffolding and the electrospun scaffolding.

The goal of this research is to characterize the biodegradable/bioresorbable scaffolds with SEM, and TEM prior to the seeding of the osteoblast cells and to examine the extent of penetration and viability of the incubated cells using the SEM (FIG 1-3). TEM has been utilized in characterizing the electrospun scaffolding samples, to examine fiber size, shape and networking between fibers (FIG 4). The SEM is used to characterize all of the scaffolding samples; information on pore size, distribution, and shape are gathered from the compression-molded samples; information on fiber size and shape and the presence of ceramic deposits are gathered from the electrospun samples. The SEM is also utilized in determining the extent of cell penetration into the scaffolding. After fixation of the cells, the samples are dried with ethanol and cross-sectioned. Prior to viewing, a thin layer of gold was sputter coated onto the samples. Once all of the samples have been characterized, a comparison will be made to determine which sample(s) are the most viable for cell growth.

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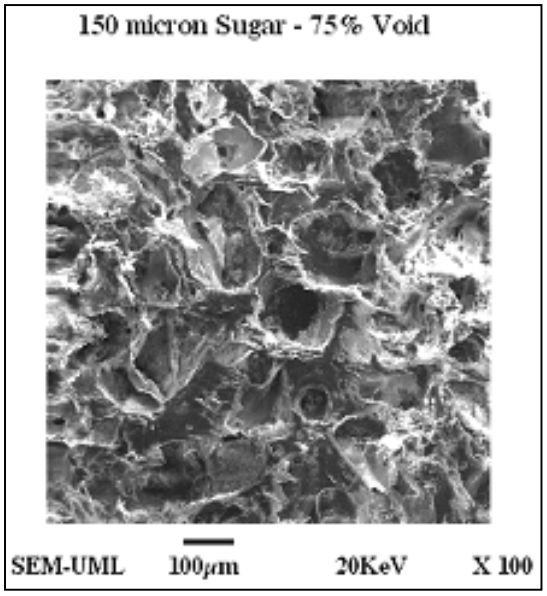

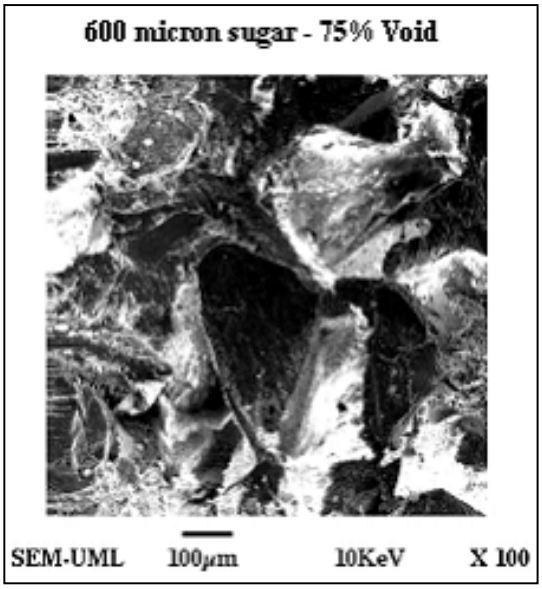

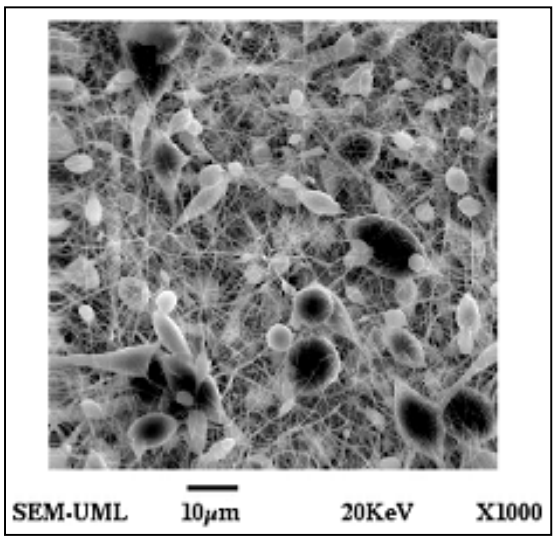

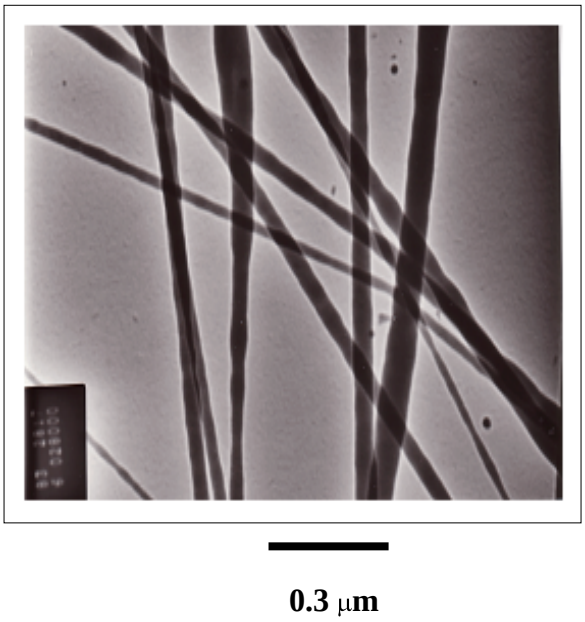

FIG. 1. SEM picture (100x) of scaffolding produced with 150 μm sugar with a 75% void space.
FIG. 2. SEM picture (100x) of scaffolding produced with whole sugar (~ 600μm) with a 75% void space.
FIG. 3. SEM picture (1000x) of electrospun polymer fibers with deposits of ceramic powder
FIG. 4. TEM picture showing the size and shape of electrospun fibers

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