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Semi-Permeable Membrane for Enhanced Periodontal Tissue Regeneration via Selective Cell Infiltration

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Periodontal disease causes irreversible loss of periodontal support tissue, which ultimately results in tooth loss. Since periodontal tissue inherently has a low capacity for self-repair, periodontal tissue regeneration is difficult to achieve. The current treatment for periodontal disease uses an occlusive barrier membrane to facilitate tissue regeneration; however, due to its lack of biological cues, the tissue rarely regenerates. In my project, we improve on the current membrane by 1) making it semi-permeable to allow critical healing components, including matrix-producing fibroblasts, to reach the damaged tissue, and 2) incorporate growth factors to as localized biological cues to further promote wound healing.

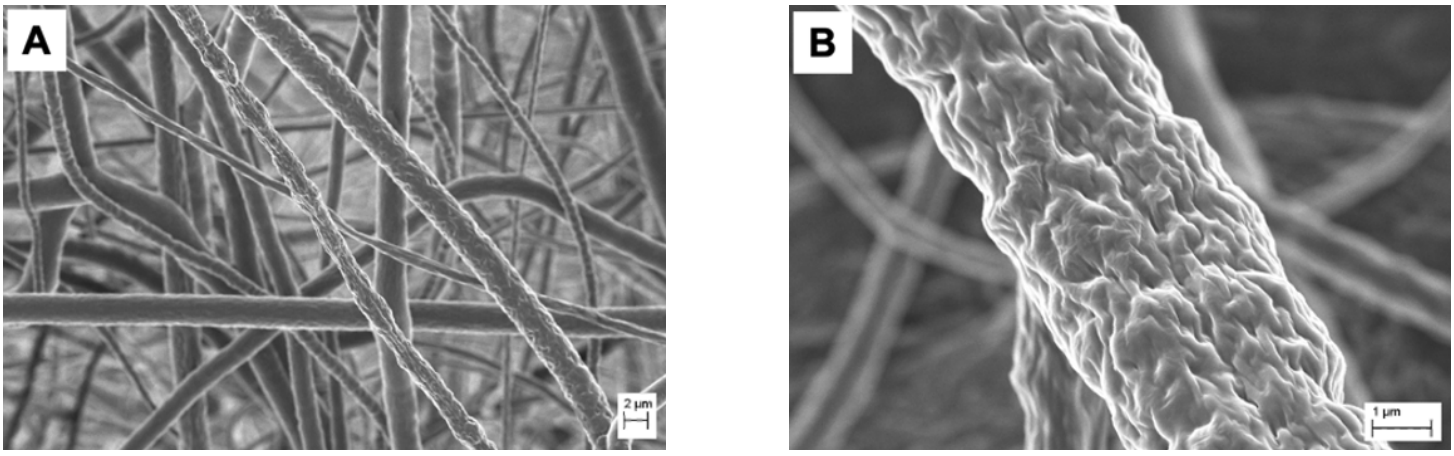

Figure 1. hPDL infiltrated the full thickens of the semi- permeable scaffold. (A,B) Electrospun polycaprolactone (PCL) nanofibers with sodium tripolyphosphate (STPP) and chitosan coating.

The semi-permeable membrane was created by electrospinning polycaprolactone (PCL). PCL was dissolved in chloroform and ethanol, and electrospun under 17kV voltage. To incorporate growth factors into the scaffold solution, growth factors were dissolved in solution that contains 1% chitosan and 0.1% sodium tripolyphosphate (STPP). This solution is electro-sprayed at 20kV simultaneously with PCL electrospinning.

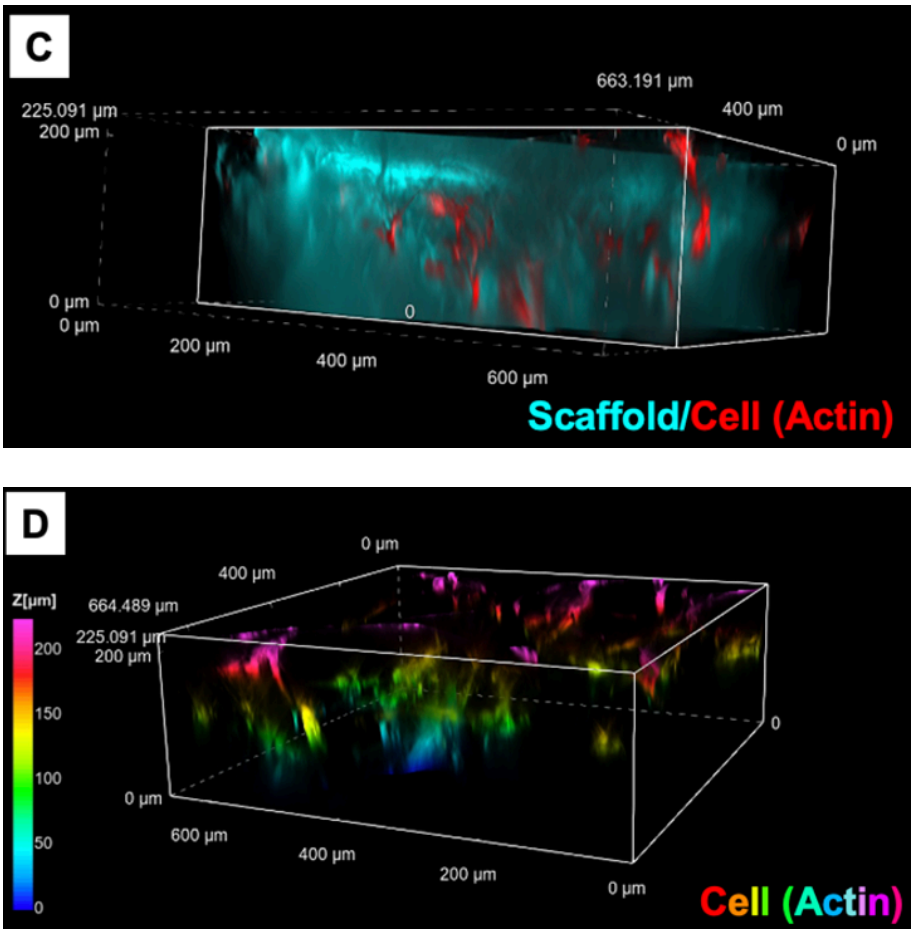

Figure 2. C) hPDL cells were seeded onto the scaffold. Actin stain shows cell location and morphology relative to the scaffold (PCL:Cyan, Actin:Red). (D) The same actin stain showed in (C) is displayed on a colour scale to show depth of cell infiltration for 24

The scaffold was coated with osmium tetroxide and imaged via LEO 1530 SEM at the Western Nanofabrication Facility (Figure 1 A-B). After seeding human periodontal ligament cells on the membrane for 24 hours, we fixed the scaffold and stained the sample with phalloidin. Immunofluorescent Deconvolution Microscopy was used to identify cell location and morphology. We observed actin stain throughout the full thickness the scaffold, which indicated that the human periodontal ligament (hPDL) cells were able to colonize and migrate through the full thickness of the semi-permeable scaffold, which is critical for tissue engineering and regenerative medicine applications.

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