Superhydrophobicitiy: Using Nanotechnology to Enhance Anti-Microbial Properties of Silicone Shunts

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Silicone cerebrospinal shunts frequently get colonized and infected necessitating repeat surgeries in shunt-dependent patients. This study manipulates silicone with nanotechnology by coating it with Single-Walled Carbon Nanotubes (SWCNT), graphene, SWCNT-Graphene bilayer, non-functionalized graphene decorated with silver nanoparticles (G-Ag), functionalized graphene (FG), functionalized graphene decorated with silver nanoparticles (FG-Ag), and Titanium (Ti) nanorods to make it superhydrophobic. Based on previous experimentation and material properties, the hypotheses were that graphene and G-Ag-coated silicone would be relatively superhydrophobic compared to Ti Nanorod coated silicone. The carbon nanomaterials and Ti Nanorods were deposited using a lifting method and machine-sputtering method respectively. Superhydrophobicity was measured by recording the contact angles of water molecules on the substrates using a computerized recording program. Superhydrophobicity was enhanced with the graphene ($p<0.0002$), G-Ag ($p<0.01$), and Ti Nanorod ($p<0.0005$) coatings. However, the SWCNT ($p<0.5337$), SWCNT-Graphene combination ($p<0.066$), FG ($p<0.094$), and FG-Ag ($p<0.94$) nanomaterial coated substrates did not reach the statistical significance. Graphene coating for its ordered, nonpolar, carbon structure, made the substrate most superhydrophobic. This would make the graphene-coated silicone shunt most resistant to colonization and infections, thereby eliminating frequent hospitalizations and shunt revisions for shunt-dependent neurosurgical patients.