Conductive collagen: A novel material for green, transient implantable electronics

In modern biomaterial based electronics, the choice of green and transient material is becoming attractive.[1, 2] This kind of materials require to have unique properties like biodegradability, bioresorbability, biocompatibility and environmentally safe.[1, 2, 3] The advantages behind using these materials are: low cost, energy efficient production due to their natural origin, no long term adverse effects, no need of retrieval as they can resorb and above all they can minimize hazardous waste for our environment.[2]

Collagen is an important biomaterial which is used in several biomedical applications. It has a triple helix structure made of polypeptide chains.[3, 4] Glycine, proline are the most abundant amino acids found in its structure. Collagen is a flexible biomaterial which is also biodegradable/bioresorbable[5], biocompatible[5] and piezoelectric[3] hence might be an ideal choice for this kind application in implantable electronics.

In this work, we present electrical properties of collagen membrane functionalized with a thin film deposited using Atomic Layer Deposition (ALD) [Figure 1a]. For this study, a commercially available bioresorbable collagen membrane was used as ALD substrate. As a preliminary pilot study, thin film of titanium dioxide (TiO_2) was deposited on collagen membrane in a custom-made ALD reactor and different film thickness was achieved by varying the number of ALD cycles. The deposition was performed at room temperature using Tetrakis(dimethylamido)titanium (TDMAT) and ozone as metal precursor and oxidizer, respectively.[6] Electrical properties of the samples were measured using a 2-probe system. Preliminary results showed that the ALD coated collagen samples were more conductive compared to non-coated control and this conductivity increased with increase in number of ALD cycles [Figure 1b].

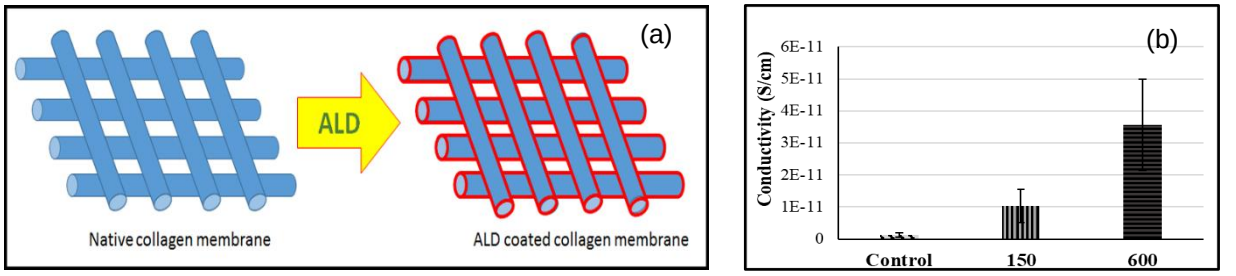

Figure 1: (a) Schematic of ALD-TiO_2 process on collagen substrate, (b) increasing conductivity of TiO_2 coated collagen with increasing thickness of TiO_2 from 150 to 600 number of ALD cycles, compared to non-coated control.

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