Supplementary Information for

2D-ice templated titanium oxide films as advanced conducting platforms for electrical stimulation

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SEM CHARACTERIZATION

Figure S1: 30-TiO$_2$ homogeneous film, sintered at 1000 °C for 1.5 h. Non-patterned surfaces were observed. Measured film thickness was ~ 2-3 μm.
Figure S2: 15-TiO$_2$ film, sintered at 1000 °C for 1.5 h. Region 1 corresponds to the furthest end of the TiO$_2$ film with respect to the cooling liquid surface. This region is composed of highly aligned grooves along the freezing direction (arrow) and it is preceded by a transitional region (region 2, neither ordered nor disordered) which links to a homogeneous non-oriented topology (region 3).
Figure S3: 5-TiO$_2$ film, sintered at 1000 °C for 1.5 h. Highly oriented parallel patterns extending throughout the whole surface were observed. Arrow indicates the freezing direction. A ’fish-bone’ morphology (typically observed for 3D-ceramic assemblies processed by directional freezing), was evidenced.
**Figure S4:** Detail of the surface seen between ridges in sample 5-TiO$_2$. It is composed of TiO$_2$ nanoparticles (although a ‘naked’ alumina surface may be also identified) but less interconnected compared to the joining bridges.
Figure S5a: 1-TiO$_2$ film, sintered at 1000 °C for 1.5 h. Highly oriented parallel patterns, this time extending perpendicularly to the freezing direction, were observed. Arrow indicates the temperature gradient direction.
**Figure S5b:** 1-TiO$_2$ film, sintered at 1000 °C for 1.5 h. Tilted grooves (at about 45° with respect to the freezing direction) were observed. This effect can be associated with a change of temperature gradient orientation during the freezing process due to nitrogen vapour fluctuations. Arrow indicates the temperature gradient direction. Ellipses show tilted features.
Figure S6: (a) Photograph of 5-TiO₂ film after the reducing treatment at 1000 °C for 3 h under H₂/Ar atmosphere. (b) Highly oriented patterns, extending throughout the whole surface, were observed after the reducing process. Arrow indicates the freezing direction.