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One dimensional nano-titanate on titanium: regulation of mesenchymal stem cells fate

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Introduction: Medical artificial bone materials has always been applied in orthopedics and dentistry , especially titanium substitutes are used worldwide for its unique characteristics in mechanics such as lower modulus and intensive corrosion resistant , superior biocompatibility. [1] Controlling the differentiation of mesenchymal stem cells into a desired specific cell lineage on the material surface is a key factor for the success of implants. [2]Meanwhile, biophysical cues and methods can regulate the fate of mesenchymal stem cells. [3] Here we designed a material which had one dimensional nano-titanate on titanium to regulate the fate of mesenchymal stem cells. We obtained micro-nano scale surface via combined selective laser melting (SLM) and alkali treatment titanium substrates.

Materials and Methods: In order to estimate the phase structure about the obtained one dimensional nano-titanate on titanium, the commercial available pure Ti(Cp Ti) treated by different concentrations of KOH solutions were analyzed by X-ray diffraction (XRD, D8A25, Bruker, Germany) in continuous mode, scanning 2θ from 20^o to 70^o with a step size of 0.02^o and the incident beam of 3^o. The morphology and composition of the titanium were further observed by a scanning electron microscopy (SEM, JSM7100F and JSM6510LV) equipped with energy-dispersive spectroscopy (EDS). The microstructure of the one dimensional nano-titanate was investigated using a transmission electron microscope (TEM, Tecnai G20) and selected area electron diffraction (SAED). *In vitro* responses of mesenchymal stem cells was evaluated by MTT、ALP、 Quantitative PCR (q-PCR)、Alizarin Red S Staining、Immunofluorescence Staining in rats.

Results and Discussion: The results demonstrated that Cp Ti treated in KOH solution with different concentration exhibited highly squid -like structures (Figure 1) . Micro-nano scale surface had great influence to MSCs.

Conclusion: In conclusion, we have demonstrated that MSCs on Ti with one dimensional nano-titanate but with different surface topographies had different adhesion, morphology, proliferation and differentiation behaviors. MSCs adhered more tightly to the Ti with one dimensional nano-titanate compared to Cp Ti. Meanwhile, Ti with one dimensional nano-titanate promoted the osteogenic differentiation of MSCs.

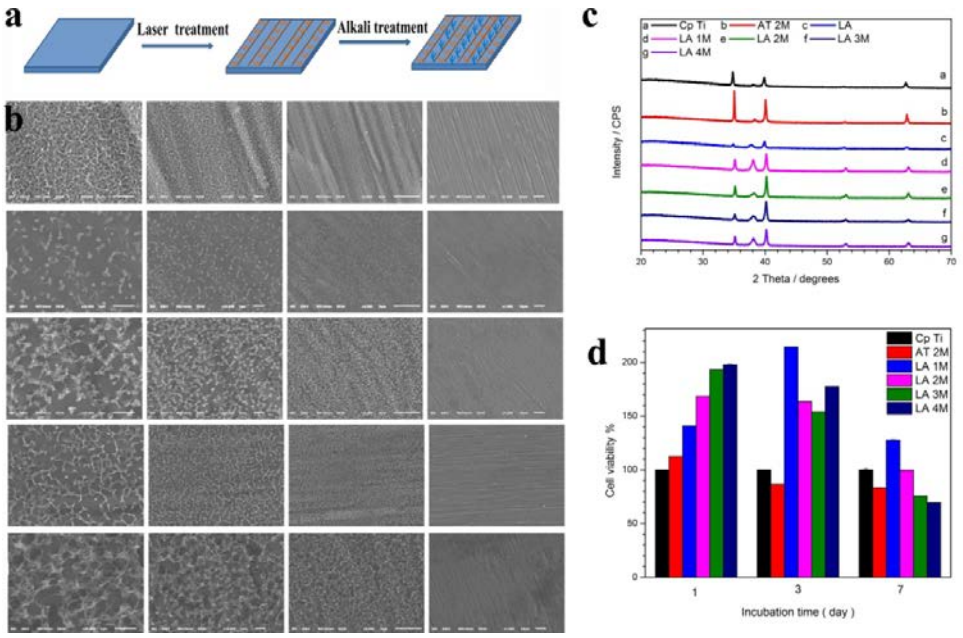

Figure 1 Synthesis and characterization of Ti with one dimensional nano-titanate. a) Synthetic procedure. b) SEM image (one dimensional nano-titanate on titanium). c) XRD analysis. d) MTT

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