Ultrafast Laser Induced Bio-Inspired Metallic Structures for Biological Response

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Bio-inspired structures often exhibit intricate structural configurations that cannot be manufactured by conventional manufacturing technologies, posing significant challenges to the advancement of biomimetic studies and their application in human [1]. These surface attributes play a pivotal role in governing the interaction between implants and the adjacent biological tissue. Surface modification and the deposition of functionalized coatings of thin films are useful for obtaining biomedical materials with biocompatible surface characteristics. The effect of Ti-based alloys with the ceramic (nitrides) on cells can be improved by tuning the surface characteristics of thin films, including their antiwear, anticorrosion, antifouling, and hydrophobic or hydrophilic characteristics. Surface functionalization using an ultrafast laser is used for a wide range of materials because of the collaborative effects of the topography and surface chemistry that are induced by this type of process [2]. In this study, by using the polarization of ultrafast laser irradiation, we induce the formation of subwavelength ripples (LIPSS) on the surface of CrTiN alloy thin films (metallic biomaterial interfaces). And, an exploration into the phase and nanocrystal structure of the patterned CrTiN surface is warranted. The results of this investigation demonstrate that ultrafast laser irradiation can enhance cell proliferation on the surface of CrTiN biomedical alloy films through the patterning of subwavelength ripples and nanocrystalline structures as illustrated in Fig 1a-d. This paves the way for a novel generation of multi-functional surfaces suitable for high-performance medical implants, and medical device technology.

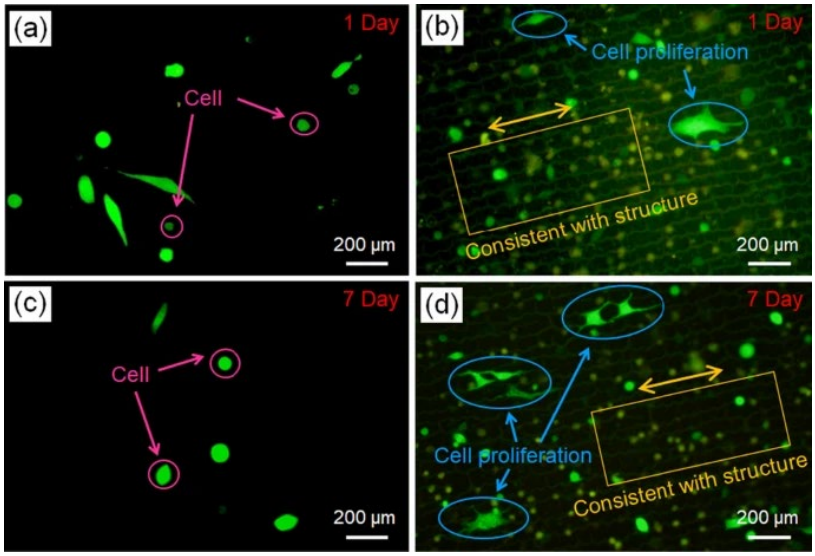

Fig 1. Fluorescence images of cell proliferation to ultrafast laser surface patterning and nanocrystalline formation on the CrTiN thin films, showing the fluorescence intensity offers the information on cell proliferation: (a-b) 1 day and (c-d) 7 days

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