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Simple and versatile synthetic polydopamine-based surface supports reprogramming of human somatic cells and long-term self-renewal of human pluripotent stem cells under defined conditions

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Human pluripotent stem cells (hPSCs) possess great value in the aspect of cellular therapies due to its self-renewal and potential to differentiate into all somatic cell types. A few defined synthetic surfaces such as polymers and adhesive biological materials conjugated substrata were established for the self-renewal of hPSCs. However, none of them was effective in the generation of human induced pluripotent stem cells (hiPSCs) and long-term maintenance of multiple hPSCs, and most of them required complicated manufacturing processes. Polydopamine (PDA) has good biocompatiblity, is able to form a stable film on nearly all solid substrates surface, and can immobilize adhesive biomolecules. In our study, carboxymethyl chitosan was used as a linker to orthogonally and controllably attach adhensive peptide to PDA coated cell culture plates for the culture of hPSCs. This synthetic surface was demonstrated that not only support the reprogramming of human somatic cells into hiPSCs under defined conditions, but also sustain the growth of hiPSCs on diverse substrates. Moreover, the proliferation and pluripotency of hPSCs cultured on the surface were comparable to Matrigel for more than 20 passages. Besides, hPSCs were able to differentiate to cardiomyocytes and neural cells on the surface. This polydopamine-based synthetic surface represents a chemically-defined surface extensively applicable both forfundamental research and cell therapies of hPSCs..

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Surface state photoelectrons in topological insulators and Weyl semimetals

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We compute the photoemission intensity and polarization for the surface states electrons in topological insulators and Weyl semimetals. The number of emitted photoelectrons is sensitive to the intensity of the laser intensity, whereas the polarization of the photoelectrons is sensitive to the chirality and topology of the surface electrons. We investigate the effect of the Zeeman field and warping. For the Weyl materials, we demonstrate the existence of the Fermi arcs which connect the opposite Weyl nodes. In the presence of a magnetic field, the effect of the EB field gives rise to the chiral anomaly which is observed as a change of the chemical potential, resulting in an enhancement of the intensity in the vicinity of one of the Weyl nodes.

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