Conductive graphene foam for cardiac tissue engineering

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Heart failure is a major international health issue. Myocardial mass loss and lack of contractility are precursors to heart failure. Although, the treatment of cardiac injury is severely limited, cardiac tissue engineering is considered to be a promising approach [1]. In native heart tissue, the cardiac muscle cells are assembled in a conductive network, so the materials selected for cardiac tissue engineering should also be conductive. In the last decades, some conductive polymers(e.g., polythiophene (PT), polyaniline, polypyrrole, metals particles, carbontube (CNT), etc.) have been developed for the cardiac tissue engineering[2].However, these material are more or less defective, such as some of them are not conductive and soft enough. In this paper we make a kind of graphene foam with size controllable holes, primary rats myocardial cells are seeded in the foam. As we know, graphene is a good conductive material, and here we make it to a unique foam structure, so cells growth in a three-dimensional space (needn't worry about the material breaking when the cells are beating) and demonstrate higher cell attachment, spreading and tissue function.

The SEM images showed in Fig.1 are the structure of graphene foam, and primary rats myocardial cells are seeded in interior holes of the graphene foam. Fig.2 shows the cell state after they have been cultured in graphene foam for several days. Our study provides a method for preparing graphene material, which can be used to study myocardial tissue engineering *in vitro*.

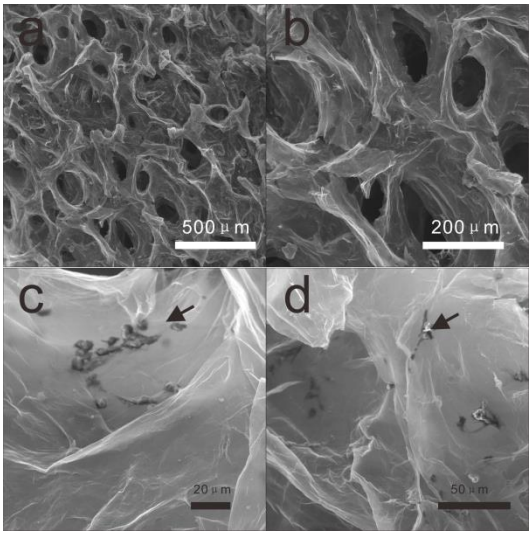

Fig.1 SEM images for the graphene foam structure and the cardiac muscle cells in holes.

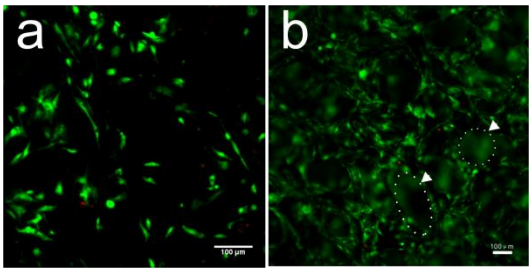

Fig.2 Three dimensional culture of cardiac muscle cells in the graphene foam scaffold and Calcein-AM/PI staining at day 2 and 10.

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[1] Annabi, N.; et al, " Highly Elastic Micropatterned Hydrogel for Engineering Functional Cardiac Tissue." *Adv Funct Mater* **2013** ,23,4950–4959.

[2]Junjie Li, and Changyong Wang, "Development of Electrically Conductive Double-Network Hydrogels via One-Step Facile Strategy for Cardiac Tissue Engineering," Adv. Healthcare Mater. **2016**, 5, 474–488