



Development of thermoresponsive poly(propylene-*g*-*N*-isopropylacrylamide) non-woven 3D scaffold for smart cell culture using oxyfluorination-assisted graft polymerisation

Avashnee S. Chetty^{a,d,*}, Viktoria Vargha^b, Arjun Maity^a, F. Sean Moolman^a, Claire Rossouw^c, Rajesh Anandjiwala^a, Lydia Boguslavsky^a, Dalu Mancama^c, Walter W. Focke^d

^a Materials Science and Manufacturing, CSIR, PO Box 395, Pretoria 0001, South Africa

^b Department of Physical Chemistry and Material Science, Budapest University of Technology and Economics, Műegyetem rkp. 3. H/1, Budapest H-1111, Hungary

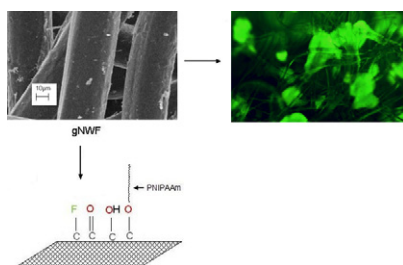
^c Biosciences, CSIR, PO Box 395, Pretoria 0001, South Africa

^d Institute of Applied Materials, University of Pretoria, Pretoria 0001, South Africa

HIGHLIGHTS

- ▶ PP-*g*-PNIPAAm NWF was synthesised using oxyfluorination-assisted graft polymerisation.
- ▶ New reactive functional groups were detected on PP surface after synthesis.
- ▶ PP-*g*-PNIPAAm displayed a thermoresponsive surface.
- ▶ Temperature triggered release of 3D hepatocytes was achieved from the scaffolds.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 16 July 2012

Received in revised form

19 November 2012

Accepted 24 November 2012

Available online 3 December 2012

Keywords:

Oxyfluorination

Graft polymerisation

Surface functionalisation

Poly(propylene) (PP)

Poly(*N*-isopropylacrylamide)

ABSTRACT

Growing cells on 3D scaffolds is far superior to the conventional 2D monolayer culture method. In this study, a novel 3D thermoresponsive poly(propylene-*g*-*N*-isopropylacrylamide) (PP-*g*-PNIPAAm) non-woven fabric (gNWF) was developed for cell culture using oxyfluorination-assisted graft polymerisation (OAGP). New polar functional groups were detected on the oxyfluorinated NWF (oNWF), and PNIPAAm was confirmed in the gNWF by attenuated total-reflectance Fourier transform infrared (ATR-FTIR) and scanning X-ray photoelectron spectroscopy (S-XPS). Scanning electron microscopy (SEM) revealed a rough surface morphology and confinement of the PNIPAAm graft layer to the surface of the fibres in the gNWF. The OAGP method did not affect the crystalline phase of bulk PP, however, twin-melting thermal peaks were detected for the oNWF and gNWF indicating crystal defects. Contact angle studies showed that the surface of the gNWF exhibited a thermoresponsive behaviour. Hepatocyte cells attached onto gNWF disks in a bioreactor at 37 °C and remained viable for 10 days in culture. Upon cooling the cell culture media to 20 °C, cells were spontaneously released as 3D multi-cellular constructs without requiring destructive enzymes. The development of 3D thermoresponsive scaffolds capable of non-invasive 3D cell culture could provide a more reliable *in vitro* model for cells.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

It is well-known that cells grown onto 3D surfaces show closer similarities to their *in vivo* counterparts in terms of cell morphologies, behaviour, and function than 2D surfaces [1,2]. A major limitation of existing 3D scaffolds however is that they rely on

* Corresponding author. Tel.: +27 12 841 3239; fax: +27 12 841 3553.
E-mail address: achetty@csir.co.za (A.S. Chetty).