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Polymer microarrays-Fabrication and biological application for cellular control and manipulation

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I will demonstrate a variety of approaches for the preparation and high-content screening of polymer microarray platform and their application in a number of cell based screens. Fabrication methods, including direct inkjet based polymer synthesis and analysis with fixed and live cells on over 10,000 features will be described. Using polymer technology, I will show how polymers have been identified and then developed for a myriad of applications, including control of stem cells fate, corneal bandages, bacterial capture and thermally responsive surfaces. This includes:

1. Polymer blends that can find use as implants which support cell attachment, growth and differentiation, and tissue regeneration *in vivo* and can be used in bone repair. This has led, for example, to polymers that are able to bind Sto+ cells and promote bone regeneration with materials now entering large animal models the first step on the road to human application
2. Polymers able to support long term highly functional hESC-derived hepatocyte like cells (showing high levels of both CYP3A4 and CYP1A2 expression) and which are now being explored as a coating on an extra-corporeal support for trials in bio-artificial liver devices
3. Polymers displaying binding or inhibition of binding of bacteria
4. Polymers that bind human stem cells, maintain them in a highly controlled state, yet allow mild thermal release, while maintaining full pluripotency.

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Highly efficient engineered materials for selective removal of heavy metals from acid mine drainage impacted waters

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Industrial development has left pronounced effects on water resources. Many industries generate waste products that contain high concentrations of heavy metals which are discharged directly or indirectly into water systems. There is an urgent need for new feasible and cost effective treatment methods. Among many remediation techniques for metal ions removal, polymeric adsorbents are efficient, feasible and widely applied. A successful approach to develop insoluble derivatives of polyethylenimine (PEI) with a phosphate, sulphate, and thiol-based functional groups for selective removal of specific elements from aqueous solutions is reported. The selectivity of the modified materials as well as their ability to be regenerated for re-use have been assessed. The cross-linked polyethylenimine (CPEI) exhibited high affinity to Cr and some divalent metal ions such as Fe, Zn, and Ni, but it showed very poor ability to bind oxo-anions such as SeO_3^{2-} and AsO_2^- which has been attributed to the unavailability of suitable functional groups to interact with these ions [1]. The phosphonated derivative (PCPEI) showed high selectivity for U[2] and As[3]. Whereas, the sulphonated derivative (SCPEI) showed high affinity towards Hg[4] and Se[5]. The existence of the chelating groups in SCPEI and PCPEI thus facilitate the removal of oxo-anions. The thiolated derivative (TCPEI) exhibited super selectivity towards Hg[6]. This study gave a background to a wider ongoing study intended to introduce polymers of this type for use in household filter systems. Another configuration is the multi-layers packing of different functionalised polymers into columns for total removal of different toxic ions.

Biography

Dalia Saad has obtained her Ph.D. very recent (Sep 2013) from Wits University, South Africa where she obtained her MSc (with distinction) in Environmental Chemistry (2011).

Her research interest is on water pollution issues and promoting access to clean healthy water. Her work involves theoretical as well as application aspects (e.g. commercialization, environmental impact and cost-effectiveness).

Dalia has presented her work in local and international conferences; she has also published several articles in reputed journals. Dalia is a member of numerous professional bodies including: Golden Key international honor society (GKIHS), Young Water Professionals (YWPs), Water institute of South African (WISA), South African Chemical institute (SACI), International Association for Impact Assessment South Africa Affiliate (IAIA), and Third World Organization for Women in Science (TWOWS).

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