



Smart Materials in medical devices for the selective removal of cells and soluble or in sunspension substances in biological fluids

www.tecnoenp.com

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Shape Memory

Materials with one or more properties that can be significantly changed by external stimuli, such as:

✓ Stress

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- ✓ Temperature
- ✓ Moisture
- ✓ рН
- ✓ Electric or magnetic fields
- Material Alloy Magnetostrictive Material Rheological Fluid Piezoelectric Material Others
- ✓ light, or interaction with M.Shahinpoor and H.-J. Schneider, Eds. Intelligent Materials; chemical compounds
 M.Shahinpoor and H.-J. Schneider, Eds. Intelligent Materials;
 Royal Society of Chemistry, Cambridge UK, 2007



Smart materials in Biomedical Field

In biomedical field, in nanomedicine, drug release, Tissue regeneration



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Functionalization



Filtering material(polimer)

SMART Material = Material plus grafted substances used for entrapping specific targets in a selective manner

The removal of desired compound from blood is an important task in the Mirandola District. It takes place thanks to chemical-physical interaction with material-compound of the biomedical device.

The idea is to introduce smart materials for the removal of specific targets (molecules, cells...)







4 different functionalizations for the specific removal of:



- Mesenchymal Stem Cells from AdiposeTissue (ADSCs)
- Cancer Cells from blood
- Lipids in blood suspension
- Apheresysis products from blood







Industrial Partner







Research Partner



ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA CENTRO INTERDIPARTIMENTALE DI RICERCA INDUSTRIALE SCIENZE DELLA VITA E TECNOLOGIE DELLA SALUTE



ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA Centro interdipartimentale di Ricerca industriale meccanica amnizata e materiali







 ➤ 4 study protocols have been standardized for testing the efficacy of prototypes realized
 → Effficacy of 30 prototypes has been studied and validated



Efficacy evaluation of prototypes for cell entrapment





Efficacy evaluation of prototypes for lipid entrapment



Evaluation of lipids concentration and apheresys products at the beginning and at the end of the circuit. Advanced microscopy approaches on the material. Hemocompatibility Tests







MAT. 'B' IMMOBILIZED CSM-TA









Smart Material for selective entrapment of cancer cells



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Not-functionalized material

Functionalization #3

Functionalized materials are able to capture cancer cells with a fold of increase up to 15 times versus Not functionalized material



Smart Material for Lipids Entrapment



We have realized an 'ad hoc' cellular model for testing 7 prototypes

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Not functionalized material



Materials for apheresys products

ANALISI			
•	Albumina	A	
•	ANTITROMBINA III		
•	Apolipoproteina A1		
•	Apolipoproteina B		
•	Amilasi isoenzimi pancreatici -	and the second	
•	Aptoglobina		
•	BILIRUBINA TOTALE E FRAZIONATA		
•	COLESTEROLO HDL	B	
•	COLESTEROLO LDL		
•	COLESTEROLO TOTALE	Static contact Selection best	
•	Complemento C3	plasma /serum	
•	Complemento C4		
•	COLINESTERASI (PSEUDO-CHE)		
•	Ceruloplasmina		
•	CREATINCHINASI (CPK o CK)		100 MV 10 COOX 4.2 CDS Field-Free 6-1 mm 41.4 pm
•	FIBRINOGENO FUNZIONALE		C Functionalization #2
•	Ferritina		
•	GOT - AST (transaminasi) -		Absorption > 40%
•	GPT - ALT (transaminasi) -		af 2 biochamical
•	GAMMA GLUTAMIL-TRANSPEPTIDASI		of 2 biochemical
•	IMMUNOGLOBULINE - IgA	A Control material	parameters
•	IMMUNOGLOBULINE -IgG		
•	IMMUNOGLOBULINE -IgM	B Functionalization #1	
•	LATTATO DEIDROGENASI (LDH)	—	
•	LIPASI [S]	C Functionalization #2	· DINAMIC LEST
•	MIOGLOBINA [S/U]		CONFIRMED THE
			RESULTS OBTAINED

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- ✓ We developed 4 smart materials → 4 technology platforms for future development of smart medical devices we tested:
 - the efficacy in capturing target cells or compound
 - the emobiocompatibility

✓ Smart materials resulted to be biocompatibility according to ISO10993- part 4 and 5

✓ New protocols are developed to mimick in lab the clinical applications of the smart materials, in a view to reduce time to marker and accelerate R&D in Life Sciences





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BBRAUN

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caring for life Serena Borghi ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA CENTRO INTERDIPARTIMENTALE DI RICERCA INDUSTRIALE SCIENZE DELLA VITA E TECNOLOGIE DELLA SALUTE

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