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INTEGRALLY SKINNED ASYMMETRIC CELLULOSE ACETATE-SILICA MEMBRANES FOR EXTRACORPOREAL BLOOD ULTRAFILTRATION

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Summary: Fluid volume management is one of the most important problems of contemporary End Stage Renal Disease (ESRD) and decompensated Congestive Heart Failure (CHF). Blood ultrafiltration (UF) is capable of the physical removal of fluid, cytokines and other toxins by convection.
This study reports the synthesis and characterization of high flux integrally skinned asymmetric Cellulose Acetate-Silica (CA-Si) membranes for extracorporeal blood ultrafiltration.
The CA-Si hybrid membranes were synthesised via the coupling of the phase inversion and the sol-gel techniques. The tetraethoxysilane (TEOS) is used as a precursor of the sol-gel reactions in acidic conditions and at room temperature. Casting solutions containing 5%, 11%, 18% and 25% (w/w) silica rendered, CA-Si5, CA-Si11, CA-Si18 and CA-Si25 membranes. The membranes were characterized by Scanning Electron Microscopy (SEM), Zeta potential, ATR-FTIR and RMN. Permeation experiments were carried out to yield Hydraulic Permeability (Lp), Molecular Weight Cut-Off (MWCO) and rejection coefficients to a set of reference solutes. In-vitro hemocompatibility was evaluated in terms of hemolysis index, thrombosis degree and platelet adhesion and activation according to the ISO 10993-4:2002 standard using pooled sheep blood anticoagulated with acid citrate dextrose (ACD) at a blood/ACD ratio of 9:1.
The CA-Si11, CA-Si18 and CA-Si25 membranes have hydraulic permeabilities of 81 kg/(hm2bar), 59 kg/(hm2bar) and 57 kg/(hm2bar), respectively. This represents an increase in hydraulic permeability compared to the CA membrane (32 kg/(hm2bar)). The corresponding MWCOs of the CA-Si hybrid membranes are 96 kDa, 111 kDa and 79 kDa. The MWCO of the pristine CA membrane is 31 kDa.
All of the CA-Si hybrid membranes can be selected for water removal with simultaneous total rejection of albumin and total permeation of urea. The efficiency of water removal and selective permeation to middle size molecules can be assessed.