Novel silica based material with nano-functional groups for analytical application

Raks V.A.[1], Myronyuk O.V.[2], Baklan D.V.[2], Lysenko O.M.[1], Konoplitska O.P.[1]

1 Department of Analytical Chemistry, Faculty of Chemistry, Taras Shevchenko National University of Kyiv, Volodymyrska 64, Kyiv-01033, Ukraine.

2Faculty of Chemical Technology, Igor Sikorsky Kyiv Polytechnic Institute, Peremohy Ave, 37, Kyiv-03056, Ukraine. E-mail: d.baklan@kpi.ua

The aim of present work was to develop novel silica-based material with nano-functional groups to extract, separate and purify myo-inositol from herbs. Developed materials, which have been surface modified to give a range of hydrophobicities/hydrophilicities, could give selective recovery of individual classes of natural compounds. Surface modification with different functional groups might tune selectivity of component recovery.

The work comprised the application of known methodologies for chemical synthesis of novel SPE-phases. Surfactants with amphiphilic nature would provide the variable functionality for targeted extraction of phytochemicals. Hence, initial extraction agents included 2,3-epoxypropoxypropyl group, surfactants Triton X-100, Brij® C10 and Brij® S10. Organosilica composites made from a bifunctional immobilized layer comprising a major fraction of hydrophilic diol groups and minor fraction of the amphiphilic long-chain nonionic surfactant. The other phase is silica modified with m-aminophenilboronic acid, that could form complexes with highly hydrophilic phytochemicals.

According to elemental analysis, the content of carbon atoms comprising the SPE-phases varies from 5.741 to 6.858 % of carbon for 2,3-epoxypropoxypropyl and Triton X-100 modifiers, respectively. For the SPE-phases containing Brij® C10 and Brij® S10 this value is up to 6.7%. Concentrations of targeted groups on the SPE-phases vary from 21.1 to 27.4 μmol·g-1 for grafted molecules of Triton X-100, Brij S10 and Brij C10. At the same time, concentration of 2,3-epoxypropoxypropyl group and m-aminophenilboronic acid is much higher (797 μmol·g-1).

Values of the concentration of targeted groups calculated from elemental analysis are well-correlated to those of thermogravimetric data. For example, according to TGA and elemental analysis data transformation of silanol groups to 2,3-epoxypropoxypropyl groups reaches up 67.61 % and 61.02 %, respectively. Slightly higher value for TGA is related to condensation of residual vicinal hydroxyl groups in the same temperature interval.

Contact information: PhD student Denys Baklan, email: d.baklan@kpi.ua