Chinese Chemical Letters Vol. 12, No. 1, pp. 71–72, 2001

A New Monodisperse Reactive Resin with Active Groups on the Particle Surface

Yu Han GUO, Tian Sheng SU*

Center for Molecule Science, Institute of Chemistry,
The Chinese Academy of Sciences, Beijing 100080

Abstract: A novel reactive resin as active support was synthesized by an improved method based on seed swelling and surface coating polymerization. The resin is monosized beads with inner nucleus of cross-linked polymer and surface layer of copolymer containing epoxy groups. The physico-chemical structures of beads were characterized.

Keywords: Monosized polymer beads, reactive resin, active support.

The cross-linked polymer beads with reactive groups as active supports have been widely used in many fields such as chromatographic separation, solid phase synthesis, catalytic reaction, ion exchange and adsorption *etc*. In resent years, the synthesis and application of monodisperse polymer beads with different structures have been rapidly developed[1~4]. It is obvious that this type of monosized resin as matrix of active supports will be even more advantageous in some applications. This paper presents a new monosized reactive resin with inner nucleus of cross-linked poly (styrene-co-divinyl benzene) and coating layer of cross-linked or non-cross-linked poly (allyl glycidyl ether) on the particle surface. The synthetical method of the resin (called PS/DVB-PAGE) was briefly described and its physico-chemical structure was characterized.

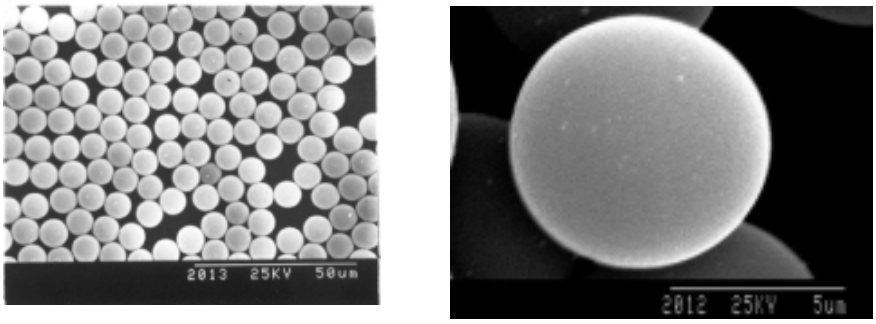
The resin was synthesized by an improved method combining seed swelling polymerization with surface coating polymerization. The monosized linear polystyrene particles (<4μm) as seeds were prepared by dispersion polymerization in organic medium[4]. The seeds were swollen by emulsifying mixture of styrene, divinyl benzene and benzoyl peroxide in aqueous solution containing stabilizer and emulsifier for about 6h at room temperature, and then were swollen continuously with emulsifying allyl glycidyl ether (with or without ethylene dimethacrylate as cross-linker) under the same conditions for about 1h, finally swollen products were polymerized in the same solution system at 70°C, usually for 24h. The polymerization products were fully washed with water. Adjusting the material ratio in effective swelling range, a series of PS/DVB-PAGE resins with different structure parameter could be obtained.

The physical and chemical structure of resins was characterized by scanning electron microscopy (SEM), infrared spectrum and elemental analysis. The particle dispersion coefficient (ε) was calculated by the following formula:

$$\varepsilon = [\sum_{i=1}^{n}(Di - \sum_{i=1}^{n}Di/n)^2 / (n-1)]^{1/2} / \sum_{i=1}^{n}Di/n$$

where *Di* and *n* were the particle diameter and the particle number of the resin determined respectively. The experiments show that the synthetic method established was simple and effective for the preparation of reactive PS/DVB-PAGE beads. The particle size of monodisperse beads were adjustable in particle diameter of 5~15μm range. Judging from statistics of the particle distribution, their ε values were less than 0.02. The SEM pictures displayed directly the particle uniformity and the apparent morphology of a PS/DVB-PAGE resin (**Figure 1**). In infrared spectrum the resins present strong absorption peak of epoxy groups at 670cm^{-1}. The thickness of coating layer copolymerized on the particle surface was controllable in 0.1~1μm range. For example the surface layer of the resin as showed in **Figure 1** is about 0.6μm, which was calculated by its oxygen content.

Figure.1 SEM picture of PS/DVB-PAGE resin. (a) particle size and distribution of a resin; (b) morphological structure of a particle surface.



The PS/DVB-PAGE resins synthesized possess both appropriate physical structure and good chemical reactivity. The beads as active supports can be conveniently transformed into various new resins with different types of functional groups by using chemical derivatization method on the particle surface under moderate reaction conditions. This type of derived resins exhibit good physical and chemical stability, the particle can withstand high-pressure operation and also can be treated with solution of pH 1~14. Monodisperse particle size, good particle rigidity and special surface structure make such derivatives as functional materials possess excellent properties, especially in the applications of different model high performance liquid chromatography.

Acknowledgment

This work was supported by the National Natural Science Foundation of China (Grant No. 29635010).

References

1. T. Ellingsen, O. Aune, J. Ugelstad. *et al., J. Chromatogr.*, **1990**, *535*, 147.
2. V. Smigol, F. Svec, *J. Appl. Polym. Sci.*, **1992**, *46*, 1439.
3. K. Ogino, H. Sato, K. Tsuchiya *et al., J. Chromatogr. A*, **1995**, *699*, 59.
4. T. S. Su, S. M. Yang, *Chinese Patent* ZL 95103038.8.

Received March 20, 2000