

## Radiation Polymerization of 4-(Acryloylamido)benzotrile: Zinc and Copper Complexes

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Received July 17, 2006; accepted (revised) November 29, 2006; published online June 28, 2007

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**Summary.** The new polymer containing cyano groups was synthesized by  $\gamma$ -irradiation. The oximated polymer was prepared using hydroxylamine hydrochloride in basic medium. The characterization of monomer, polymer, and oximated ones was confirmed by infrared and nuclear magnetic resonance spectroscopy. The complex formation of the amidoxime salt towards  $Zn^{II}$ ,  $Cu^{II}$ , and  $Zn^{II}/Cu^{II}$  mixture in aqueous solution was studied by atomic absorption spectroscopy, energy dispersive spectroscopy, and electron spin resonance spectrometry. The significant binding capacity of these metal ions revealed its selectivity to Zinc(II) ion. The thermal stability of polymers and complexed ones was investigated using thermogravimetry analysis. The change in their morphology was observed by scanning electron microscopy (SEM).

**Keywords.** Oximated polymer; Complex formation; Thermal stability; Morphology.

### Introduction

There are numerous studies on extraction of toxic metal ions in industrial effluent, waste, and seawaters. Unconventional materials have been used as absorbants for this purpose [1–3]. Chelating polymers have been playing an important role in this field, in particular those containing amidoxime groups are most promising candidates. Amidoximated polymers have been widely exploited to recover uranium [4] from seawater. Recovery of gold [5], chromium [6], mercury [3], copper [6], and a series of other metal ions from aqueous solution has been reported recently [7, 8]. Divinylbenzene cross-linked

poly(acrylamidoxime) resins were obtained and utilized successfully in the determination of trace metals in natural water [9]. The synthesis of new polymer ligands has great practical applications [10]. The reaction of acryloyl chloride or methylacryloyl chloride with the corresponding amines to prepare new functional monomers has been reported [11, 12]. Most of these polymers are prepared by employing the conventional method of chemical initiator [11, 13] or irradiation technique [14, 15].

The main objective of the present work is to prepare a new polymer containing amidoxime moiety and investigate the complexation capacity towards metal ions in solution. This was achieved by preparing the new monomer containing cyano group, 4-(acryloylamido)benzotrile (AMBN), which was then polymerized by  $\gamma$ -irradiation. The reaction of this polymer with hydroxylamine hydrochloride gave the required amidoximated polymer. Physicochemical characterization was accomplished using infrared (IR), nuclear magnetic resonance (NMR), electron spin resonance (ESR), atomic absorption spectroscopy (AAS), and thermogravimetric analysis (TGA).

### Results and Discussion

#### *Characterization of Monomer and Polymer*

The reaction between acryloyl chloride with 4-aminobenzotrile was carried out in dry acetone, for about 1 h. Saturated ammonium carbonate solution

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