

Abstract

The development of photonics and nonlinear optics requires the design of new functional materials with properties tailored to specific applications. A particularly interesting group of such materials consists of photochromic polymers containing azobenzene chromophores, which are capable of reversible *trans*→*cis* photoisomerization and exhibit a variety of light-induced effects. These properties determine their application potential in modern optical technologies.

The aim of this work was to evaluate a new class of methacrylic copolymers functionalized with quinoline-based azo dyes with respect to their potential applications in photonics and nonlinear optics, and to determine the relationships between the chemical structure of the chromophores and the properties of the investigated materials. A series of sixteen copolymers was characterized in terms of their optical, photochemical, and photophysical properties, with a focus on photoisomerization and thermal isomerization, photoinduced mass transport, and third-order nonlinear optical properties.

It was demonstrated that the key factors influencing the properties of the investigated materials are the electron-donating or the electron-withdrawing strength of the substituents and their position within the chromophore structure. A relationship between the electronic properties of the substituents and the absorption maximum wavelength, the rates of photoisomerization and thermal isomerization, the efficiency of photoinduced mass transport, as well as the two-photon absorption cross-section and the nonlinear refractive index was revealed. Furthermore, high photoinduced mass transport efficiency was observed for the copolymer containing a diethylamino substituent in the *para* position of the chromophore's phenyl ring. Moreover, enhanced two-photon absorption was observed for polymers containing quinoline-based azo chromophores compared with structurally simpler azobenzene systems. The obtained results provide guidelines for the design of new photochromic materials intended for applications in photonics and nonlinear optics.