Polyelectrolytes are polymers in which a major quantity of the constituent units contain ionizable or ionic groups or both. The polyelectrolytes with phosphonic acid groups improve the adhesion in paints and glues; they are used in the formulation of fibers and films of high mechanical resistance or as metal ion exchangers. In the present work we report the synthesis of two new polyelectrolytes, poly(p- and o-acrylamidophenyl-phosphonic acid), which were made through the chemical modification of poly(p- and o-bromophenylacrylamide) polymers using a Michaelis-Arbuzov reaction and subsequent acid hydrolysis. The polyelectrolytes were used to form and stabilize Au nanoparticles using the colloidal method. The UV-Vis results showed that both polyelectrolytes act as Au$^{3+}$ ion reducing agents and Au nanoparticle stabilizer. The nanoparticles obtained remained stable for several months in the colloidal solution. The TEM characterization showed gold nanoparticles with an average controlled size of 11 nm. Nanoparticles with a quasi-spherical shape were obtained with the poly(p-acrylamidophenylphosphonic acid) and anisotropic nanoparticles such as decahedron and dodecahedron were obtained with the poly(o-acrylamidophenylphosphonic acid).

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