Radiation effects under spatial confinement: high energy ions in polymer ultrathin layers

*R. M. Papaléo**

Faculty of Physics, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Brazil

Ion Implantation Laboratory, Federal University of Rio Grande do Sul, Porto Alegre, Brazil

In this talk, I´ll briefly review recent results in our group on ion irradiation of polymer thin and ultrathin films, used as a model system to investigate confinement effects of ion tracks in one dimension. We followed the changes in radiation effects as the thickness is systematically reduced from ~ 100 nm down to ~2nm. Two types of experiments were conducted for ions in an energy range from 2 MeV up to 2 GeV: one involving individual ions (surface effects, such as cratering and mass transport in single ion impacts) and another based on average effects of high-fluence irradiations (to get information on bond-breaking rates). Surface effects produced by swift heavy ions associated to mass transport and particle ejection are weakened when the length of the ion track is spatially confined. The deviation from bulk-like behavior starts at a critical thickness as large as 40nm in PMMA, initially because long-range effects associated to *cooperative* action of excited material along the ion path are reduced. The critical thickness below which thickness-dependent effects become strong depends on the type of event considered and to what extent it depends on cooperative effects. Bond breaking, being a result of more localized energy deposition events, show, for example, almost no change upon spatial confinement. Such high-fluence experiments, used to extract damage cross sections are, however, much more challenging to handle, because of the unavoidable macroscopic changes on the target characteristics during irradiation.