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Tissue engineering is a promising, relatively new area focused on the development of new tissue created by synthetically produced biomaterials. New generations of synthetic biomaterials are being developed at a rapid pace for use as three-dimensional extracellular microenvironments to mimic the regulatory characteristics of natural extracellular matrices (ECMs) and ECM-bound growth factors, both for therapeutic applications and basic biological studies. Our group has recently engineered radiation-induced biomaterials, which provides the capacity to control its bioactive molecule grafting and physical properties such as degradation rate, swelling, and mechanical properties by varying the degree of biomaterials after gamma-irradiation or electron beam-irradiation. These materials have already found application in maintaining functional stem cells and in differentiating stem cells various tissues. Also, the ability of radiation-induced biomaterials to better support human mesenchymal stem cell attachment and spreading compared to unmodified materials, demonstrating the promise of this biomaterial with defined architecture and cell adhesive properties for tissue applications.