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Growing integration layer strategy: Fabrication of multilayer nanostructured ceramic coatings and/or films on metallic materials in solution

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We have proposed a novel concept and technology of the formation of growing integration layer (GIL) method, where GIL(s) can be prepared via integration of ceramic film formation from a component of the metallic materials by chemical and/or electrochemical reactions in a solution at low temperature of RT-200^{o}C. They have particular features: Widely diffused interface(s); continuously graded layers grown from the bulk (substrate) and; low temperature process, etc. They are quite different from so-called layer-by-layer (LBL) strategy, where every layer is deposited from the top. $BaTiO_3$ or $SrTiO_3$/TiOx GIL films on Ti plates formed by hydrothermal-electrochemical method showed good adhesion. $CaTiO_3/Al_2O_3/Ti_2Al$ GIL films on TiAl exhibited excellent adhesion and anti-oxidation performances. On a Ti-base bulk metallic glass, we could succeed to prepare bioactive titanate nano-mesh layer by hydrothermal-electrochemical techniques at 90-120^{o}C. We can make carbon films with various nanostructures on metal carbides by leaching out of metal component(s) by chemical and electrochemical etching at ambient conditions, which can be called as reverse integration.

Since GIL have particular features described above, the GIL method can be applicable for wide variety of applications like thermal barrier, mechanical parts, environmental and/or chemical coating, conducting and or insulating films, biological and/or medical coating, etc.

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