INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	**Ph.D.**

Thesis Title: **Studies on Poly (Lactic Acid) and Polysaccharide Gum based Bionanocomposites for Adhesive and Gas Barrier Film Applications**

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SHORT ABSTRACT

The PhD thesis work was focused on Poly (Lactic Acid) and Polysaccharide Gum based Bionanocomposites for Adhesive and Gas Barrier Film Applications. The various polysaccharide gums such as gum arabic, guar gum, xanthan gum and gum rosin were tested for the two applications. The monomer of lactic acid was grafted with the polysaccharide gums by conventional heating and microwave heating method by polycondensation reaction. The grafted composites were tested as an adhesive for structural applications and food packaging applications. The preliminary tests were conducted by the two synthesis methods and the grafting in the composites were studied. Among all the gums, gum arabic was selected as it proved to be the best for the desired applications. It is observed that during the synthesis of GA-*g*-PLA, hydrophilic gum was converted into hydrophobic due to grafting of in situ grown hydrophobic *oligo*-(lactic acid). The grafting at GA backbone with *oligo*-(L-lactic acid) (OLLA) chains was confirmed by FTIR and NMR analyses. The single lap shear test was performed to check the binding ability of the synthesized bio-based adhesive. The bio-based adhesive showed excellent adhesive strength for glass and granite substrates. Subsequently, the solution casted PLA/GA-*g*-PLA bionanocomposite films showed path breaking reduction in oxygen permeability (OP) i.e. ~10 folds reduction in oxygen permeability was achieved in case of PLA

films containing GA-*g*-PLA as filler. The reduction in water vapour transmission rate (WVTR) was also observed upto 27% on addition of 5 wt% filler. Reduction in OP of this order of magnitude enable the PLA to compete with PET in terms of enhancing shelf life and maintaining the food quality. The thermal degradation behaviour of poly lactic acid (PLA) and gum arabic-grafted-poly l-lactic acid (GA-g-PLA) based bionanocomposite films were also studied using from Kissinger, Augis & Bennett, Flynn-Wall-Ozawa and Kissinger-Akahira-Sunose models. Thermogravimetric Analysis hyphenated with Fourier Transform Infrared Spectroscopy (TGA-FTIR) is conducted to study the evolved gaseous products from PLA and PLA/GA-g-PLA samples, for interpreting the degradation pathways.