

# Smart Materials & Structures

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## Development of piezoelectric properties in PVDF: Effect of particle concentration and stretching variables

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Polyvinylidene fluoride (PVDF) has relatively high thermal stability (~120 °C) with moderate piezoelectric coefficient ( $d_{33}$  ~30 pC/N) while cellular polymers such as polypropylene (PP) has higher  $d_{33}$  value (120-600 pC/N) with poor thermal stability (up to around 50 °C) which limited their applications in high temperature transduction. Therefore, a three-phase composite has been studied where organoclay has been added to enhance polar  $\beta$  phase and  $\text{CaCO}_3$  to introduce cellular structure in PVDF to get the advantage from both source of piezoelectricity with thermal stability. The samples were prepared by mixing PVDF, organically modified nanoclay (1-12 wt%) and  $\text{CaCO}_3$  (30-40 wt%) into a twin screw extruder and subsequent calendaring of films with thickness around 100  $\mu\text{m}$ . FTIR result showed that although the supplied  $\text{CaCO}_3$  is not surface modified, still it results in around 30% of  $\beta$  phase in PVDF in absence of nanoclay and a gradual increase was observed in  $\beta$  phase with increasing amount of  $\text{CaCO}_3$  and this increment was further elevated by adding surface modified organoclay. Though various percentage of clay was used, 3 wt% of them seems to contribute maximum  $\beta$  phase (~55%) due to better dispersion and DSC as well as XRD confirmed the results further. Maximum 87%  $\beta$  phase was found in PVDF/40 wt%  $\text{CaCO}_3$ /3 wt% nanoclay sample after stretching at a ratio ( $R$ =final length/initial length) of 4.5 at 90 °C. Seemingly, increased stretching ratio not only improved the  $\beta$  phase content but also created harmonious voided structure around  $\text{CaCO}_3$  particles in the sample. SEM on stretched film showed the presence of such lenses shaped voided structure inside the film.

### Biography

Nusrat Jahan has completed her MSc from Tuskegee University, USA and currently pursuing PhD in Ecole Polytechnique de Montreal, Canada. She has published 5 papers in journals and in a couple of proceedings.

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