RSC Advances

RSCPublishing

PAPER

Flexible and enhanced thermal conductivity of Al_2O_3@Polyimide hybrid film *via* coaxial electrospinning

Cite this: DOI: 10.1039/x0xx00000x

Received 00th January 2012,
Accepted 00th January 2012

DOI: 10.1039/x0xx00000x

www.rsc.org/

Jianwen Xia,[ab] Guoping Zhang,[a,c] Libo Deng,[a] Haipeng Yang,[b] Rong Sun,[a*] and Ching-Ping Wong[a,c]*

A novel core-shell structure of Al_2O_3 nanoparticles (NPs) attached on poly (amic acid) (PAA) fiber has been successfully developed by facile coaxial electrospinning technology for the first time. The as-prepared PAA fiber went through imidization to prepare Al_2O_3@polyimide (Al_2O_3@PI) film. The resultant films with different Al_2O_3 contents are characterized by scanning electron microscopy, Fourier transform infrared spectroscopy, thermal gravimetric analysis, and dynamical mechanical analysis, respectively. The results indicated that the Al_2O_3 NPs could uniformly coat the surface of fibers with a diameter of about 1 μm which enhanced thermal and mechanical properties of fiber-based film. Especially for the flexible film with the content of Al_2O_3 as high as 59.3 wt%, it present a high storage modulus (2.11GPa) and excellent thermal stability (474 ºC at 5% mass loss) as well as superior thermal conductivity of 9.66 $Wm^{-1}K^{-1}$ in plane. At last, compared with pure PI film, the Al_2O_3@PI fiber-based film exhibits excellent thermal transfer ability in the light emitting diode packaging. Therefore, the novel Al_2O_3@PI fiber-based film with integrated properties of insulation, thermal conductivity and flexibility can be used for wearable electronics and power devices.

Supporting information

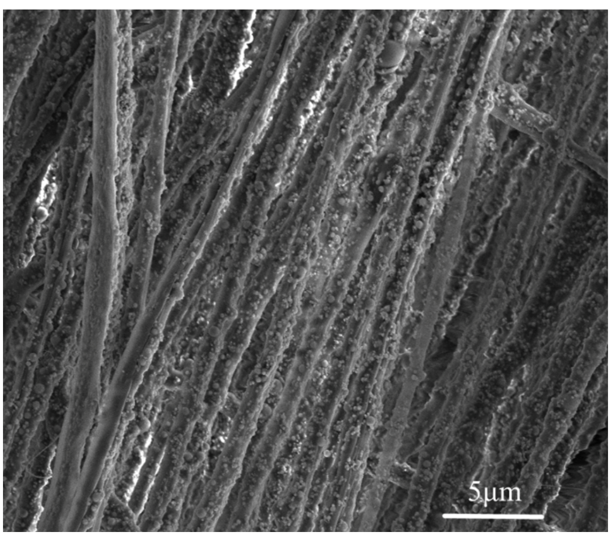

Fig. S1 SEM image of 74.5 wt% Al_2O_3@PAA with PVP

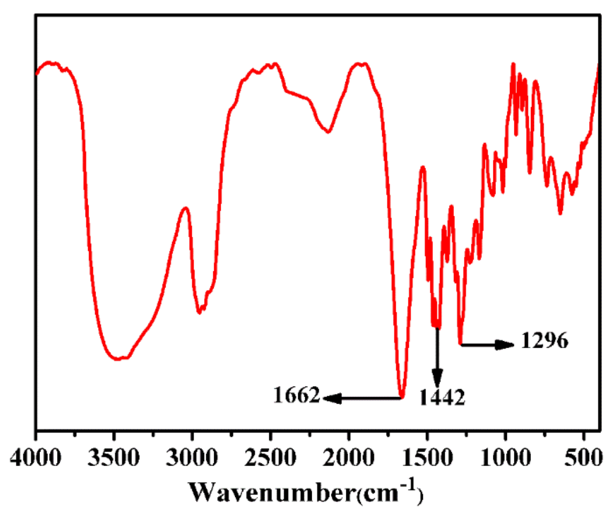

Fig. S2 FTIR spectrum of PVP

Table S1 The thermal properties of composites with different contents of Al_2O_3 NPs

Al_2O_3 (wt%)	Density ($g \cdot cm^{-3}$)	Heat capacity ($J \cdot K^{-1} \cdot g^{-1}$)	Thermal diffusion ($mm^2 \cdot s^{-1}$)	Thermal conductivity ($W \cdot m^{-1} \cdot k^{-1}$)
0	0.669	1.187	4.789 ± 0. 544	3.80 ± 0.43
26.7	0.990	1.182	4.834 ± 0. 626	5.66 ± 0.73
42.2	1.233	1.141	5.107 ± 0.330	7.18 ± 0.46
59.3	1.300	1.062	7.000 ± 0.234	9.66 ± 0.32
74.5	1.492	0.916	7.242 ± 0.320	9.90 ± 0.44