STRUCTURAL DYNAMIC CHARACTERIZATION OF BIOBASED MICRO AERIAL VEHICLES

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ABSTRACT

Micro Aerial Vehicle, MAVs is latest generation of aircraft inspired from micro natural fliers. Mimicking those fliers need extensive research and fine tools. Besides flight dynamics, propulsion system and structures integrity, wings plays a very important role in creating lifts and vortices to make a successful liftoff. MAV wings subjected to enormous level of mechanical stress due to flapping frequencies and posses a wide area to scope air. With all those bombardment, MAV wings should perform in a harmonize way with the stress being generated, yet the wing should be keep at minimum weight as possible. This research work is intended to investigate the mechanical properties of thin film PVA with biomimetic units drawn on the surface on the film for the application of MAV wing membrane. Biomimetic units grid, striation, spot were drawn on the surface of PVA thin film by means of heated geometry cutter. A control specimen named no pattern were then compared with the biomimetic specimen in terms of tensile testing for mechanical properties, DMA analysis for viscoelastic properties and DSC analysis for percentage of crystallinity. Result shows grid specimen exhibit highest level of mechanical properties and viscoelastic properties. This is due to the percentage of crystallinity formed in grid was the highest and thus elevate the mechanical properties of PVA thin film. Heated geometry cutter creates localized heat to melt the polymer and solidify quickly which crystallize the edge of the drawn pattern and in turn improve the mechanical properties when compared to pure PVA thin film.

ABSTRAK

Kenderaan Udara Mikro, MAV adalah generasi terbaru pesawat diilhamkan daripada alam semulajadi mikro. Kajian terhadap sumber alam mikro adalah menyeluruh dan amat halus dalam konteks kejituan. Selain penerbangan dinamik, sistem pendorongan dan integriti struktur, sayap memainkan peranan yang amat penting dalam mewujudkan pengapungan dan vorteks untuk penerbangan yang berjaya. Sayap MAV tertakluk kepada tekanan mekanikal disebabkan kekerapan mengepak dan mempunyai kawasan yang luas untuk mengepung udara. Dengan itu, sayap MAV perlu menerima tekanan luar dengan cara menyelaraskan dengan tekanan yang dihasilkan, dan sayap juga perlu mempunyai berat yang minimum. Kerja penyelidikan ini bertujuan untuk menyiasat sifat-sifat mekanik filem nipis PVA dengan unit biomimetic yang dilukis pada permukaan pada filem itu untuk aplikasi dalam membrane sayap MAV. Unit Biomimetic grid, striation , dotted telah disediakan di permukaan PVA filem nipis dengan menggunakan pemotong geometri panas. Satu sampel kawalan dinamakan no pattern kemudiannya dibandingkan dengan spesimen biomimetic dari segi ujian tegangan bagi sifat-sifat mekanik, analisis DMA untuk kajian viscoelastic dan analisis DSC peratusan penghabluran. Keputusan menunjukkan spesimen grid mempunyai tahap tertinggi dalam sifat-sifat mekanik dan sifat-sifat viscoelastic. Ini adalah kerana peratusan penghabluran ditubuhkan pada grid adalah yang tertinggi dan dengan itu meningkatkan sifat-sifat mekanik PVA filem nipis. Pemotong geometri panas menghasilkan haba setempat untuk mencairkan polimer dan mengukuhkan cepat yang menghablur pinggir corak yang dilukis dan seterusnya memperbaiki sifat-sifat mekanikal berbanding PVA filem nipis yang tulen.

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LIST OF SYMBOLS AND ABBREVIATIONS

wt	-	weight percentage
δ	-	Delta
°C	-	Celsius
T_c	-	Crystallization temp
C_p	-	Heat capacity
T_m	-	Melting temperature
N	-	Force
F	-	Load
Hz	-	Hertz
μ	-	Micro
%	-	Percentage
σ	-	Stress
g	-	Gram
mm	-	Milimeter
pH	-	Hydrogen potentia
J/g	-	Enthalpy for 100% crystals
MPa	-	Megapascal
GPa	-	Gigapascal
ASTM	-	American Society for Testing and Materials
DSC	-	Differential scanning calorimetry
DMA	-	Dynamic mechanical analysis
PVA	-	Polyvinyl alcohol

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