The Development of Sn-Cu-Ni Lead Free Composite Solder Influence by Non-Metallic Reinforcement

by

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A thesis submitted in fulfilment of the requirements for the degree of
Master of Science in Materials Engineering

School of Materials Engineering
UNIVERSITI MALAYSIA PERLIS

2016

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ACKNOWLEDGEMENT

Bismillah, Alhamdulillah thanks to Allah s.w.t for His blessing in completing my master project generally thus fulfil my master specifically. Firstly, I would like to express my sincere appreciation to my motivated and respected project supervisor, Dr Norainiza Bt. Saud for her encouragement, guidance, criticism, and support to me to completing this project.

Special thanks are extended to my Co supervisor Dr Mohd Nazree B. Derman, who was very helpful during my project by giving and sharing a lot of ideas and information about my project. I would also like to express my appreciation to Mohd Arif Anuar B. Salleh for his continuous assistance, advice, and motivation to me, throughout the whole process to complete my research. I am very grateful to him for keeping having faith and confidence to entrust me to complete this important project.

I also would like to thank the University Malaysia Perlis (UniMAP) and Nihon Superior, Japan for providing me the facilities and material during this project. Many thanks to lecturers, PLVs, and technicians for assisting and giving me the opportunity and permission to run and operate all the machines and equipment related to the research. I would also like to acknowledge the help from my entire friend, especially my team member electronic packaging for their friendship and advice. I was very thankful for their kindness and patience in helping me during my hard times only Allah could pay their kindness.

Last but not least to my family for their support, courage, and blessing always by my side in my up and down. I really do appreciate it. I express the utmost gratitude to all of them that deserve my thanks, which have contributed toward the success of this research, and their name that not mention here. Thank you so much.

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LIST OF ABBREVIATIONS

AC	Activated Carbon
Al_2O_3	Aluminium Oxide
Co	Cobalt
CTE	Coefficient of Thermal Expansion
Cu	Copper
DSC	Differential Scanning Calorimetry
EDX	Energy Dispersive X-Ray Spectroscopy
HCl	Hydrochloric Acid
HNO_3	Nitric Acid
IMC	Intermetallic Compound
MWCNT	Multi-Walled Carbon Nano Tube
Nd	Non-Detected
Ni	Nickel
OM	Optical Microscope
PCB	Printed Circuit Board
PM	Powder Metallurgy
SAC	Sn-Ag-Cu
SEM	Scanning Electron Microscope
Si	Silicon
Si_3N_4	Silicon Nitride
SiC	Silicon Carbide
SMT	Surface-Mount Technology
Sn	Tin

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Sn-Pb	Tin-Lead
SWCNT	Single Walled Carbon Nano Tube
TiO_2	Titanium Oxide
WEEE	Waste Electrical and Electronic Equipment
Wt	Weight
XRD	X-Ray Diffraction

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LIST OF SYMBOL

Tm	Melting temperature
A	Area
t	Thickness
L	Length
ρ	Rho
s	Spacing
v	Voltage
I	Current
Ts	Solidus temperature
TL	Liquidus temperature

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Pembangunan Pateri Komposit Sn-Cu-Ni Bebas Plumbum Dipengaruhi Oleh Penguat Bukan Logam

ABSTRAK

Untuk beberapa dekad, aloi Sn-Pb telah digunakan secara meluas sebagai bahan pematerian dalam industri pembungkusan elektronik. Walaupun begitu disebabkan kebimbangan mengenai ketoksikan plumbum dalam bahan pateri SnPb eutectic, penyelidikan telah memberi tumpuan kepada pembangunan pateri bebas plumbum. Tumpuan utama adalah untuk membangunkan satu generasi baru bahan sambung yang dilengkapi dengan gabungan mekanikal, elektrik dan sifat-sifat haba yang memenuhi keperluan industri elektronik. Dalam projek ini, generasi baru bebas plumbum (Sn-Cu-Ni) aloi pateri telah dibangunkan untuk membentuk pateri komposit. Lima pateri bebas plumbum komposit baru telah berjaya dihasilkan menggunakan kaedah metalurgi serbuk, yang terdiri daripada pencampuran, pemadatan, dan proses pensinteran. Kajian ini juga dibantu oleh bantuan gelombang mikro yang membantu proses pensinteran hibrid, yang menunjukkan kelebihan dalam pemprosesan berbanding kaedah konvensional pensinteran, seperti kadar pemanasan pesat, masa pensinteran dipendekkan, penggunaan tenaga yang kurang dan peralatan yang lebih murah. Lima bahan bukan logam (Silikon nitrida, Titanium oksida, Silikon karbida, Silikon dan Karbon) dengan pelbagai peratusan (0, 0.25, 0.5, 0.75 dan 1.0 wt.%) telah dimasukkan ke dalam matriks pateri. Mikrostruktur, elektrik, haba, ciri-ciri fizikal, dan sifat-sifat mekanikal komposit pateri telah disiasat. Penambahan tetulang zarah ke dalam matriks pateri Sn-Cu-Ni membawa kepada peningkatan prestasi haba dan prestasi mekanikal. Hasil kajian juga telah menunjukkan tiada perubahan suhu lebur dan prestasi elektrik. Kehadiran zarah tetulang adalah berkesan dalam merencatkan pertumbuhan lapisan antara logam ke atas Cu-substrat. Kekuatan ricih pateri komposit telah bertambah baik dengan penambahan tetulang zarah. Semua pateri komposit sistem juga menunjukan kebolehbasahan yang lebih baik dengan peningkatan sudut pada Cu-substrat berbanding pateri tanpa tetulang. Hasil pembelauan x-ray menunjukan bahawa tiada fasa tindak balas baru yang berlaku dalam sistem komposit baru. Secara keseluruhannya, Sn-Cu-Ni pateri komposit menunjukkan peningkatan berbanding pateri tanpa penambahan dan Sn-Cu-Ni+AC adalah pateri komposit yang paling baik. Sifat-sifat mekanikal yang cemerlang manjadikan Sn-Cu-Ni+AC adalah pateri altenatif dan pilihan ideal untuk menggantikan pateri bebas plumbum dalam industri elektronik.

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