Joint Material for power semiconductors by Cu-Sn Intermetallic Compound (IMC)

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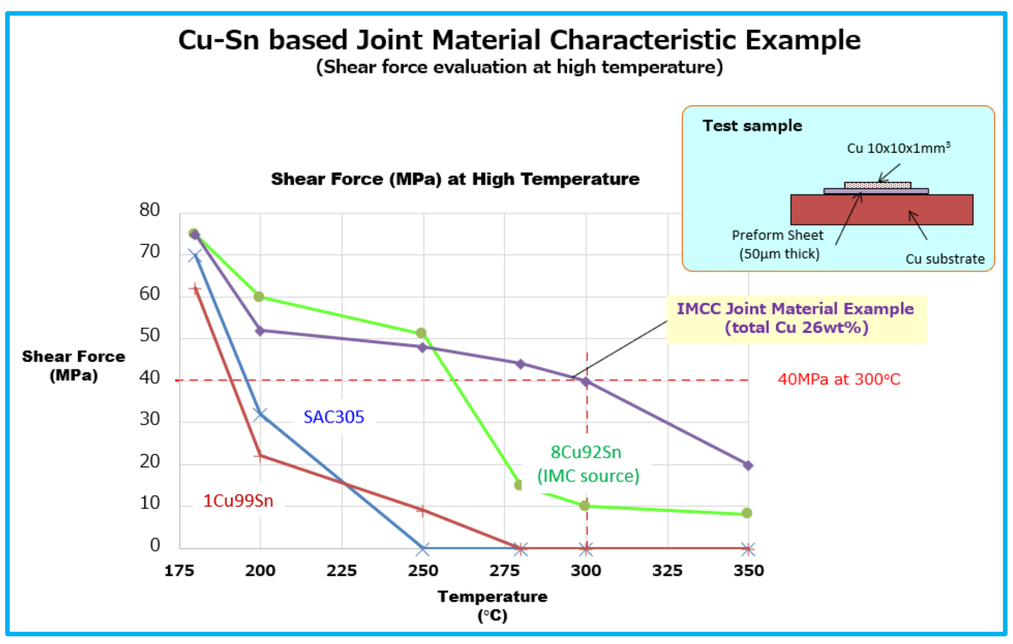
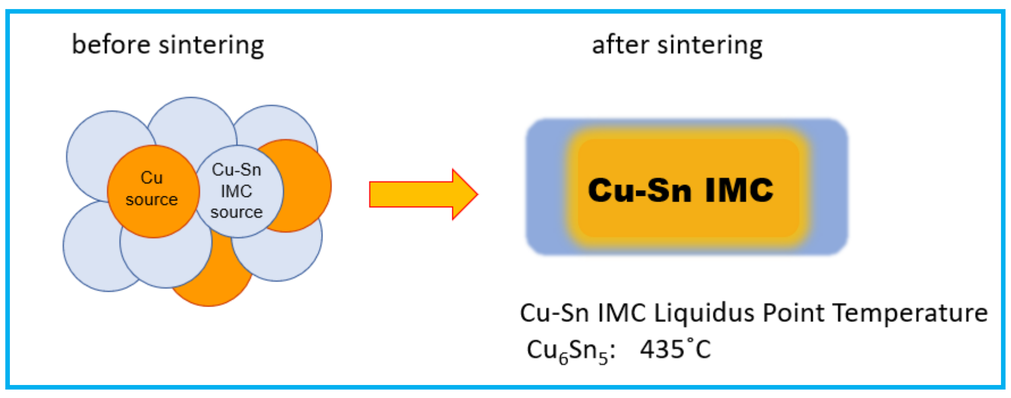
[Overview]

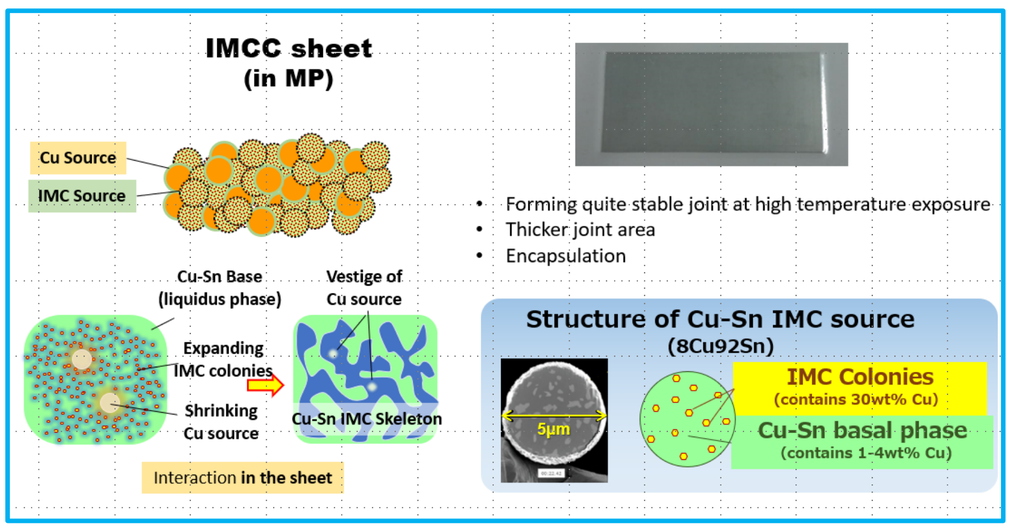
We developed heat resistant joint material only using base metals (Cu and Sn) mainly for power semiconductors' assembly. By sophisticated control of Cu-Sn Intermetallic Compound (IMC) forming procedure, the joint region after sintering has IMC skeleton structure to provide robust and stable joint characteristics. The key components of the developed material are fine particles of Cu source and IMC source. The IMC source contains 8wt% Cu and 92wt% Sn. Re-melting point of the joint material (preform-sheet and paste) can be above the sintering temperature. Even using Sn rich component (IMC source), the evaluation indicated no whisker in joint area after TCT 1,000 cycles (-55~+175°C) and no allotropic transformation of Sn (between α-phase and β-phase). The joint test using IGBT, SiC and GaN, we confirmed the joint structure keeps its initial condition even after 1,000 cycles TCT without critical cracks/delamination/voids. The joint material (we call it Intermetallic Compound Composite; IMCC) is not only for power semiconductor die attach but also for MEMS device encapsulation.

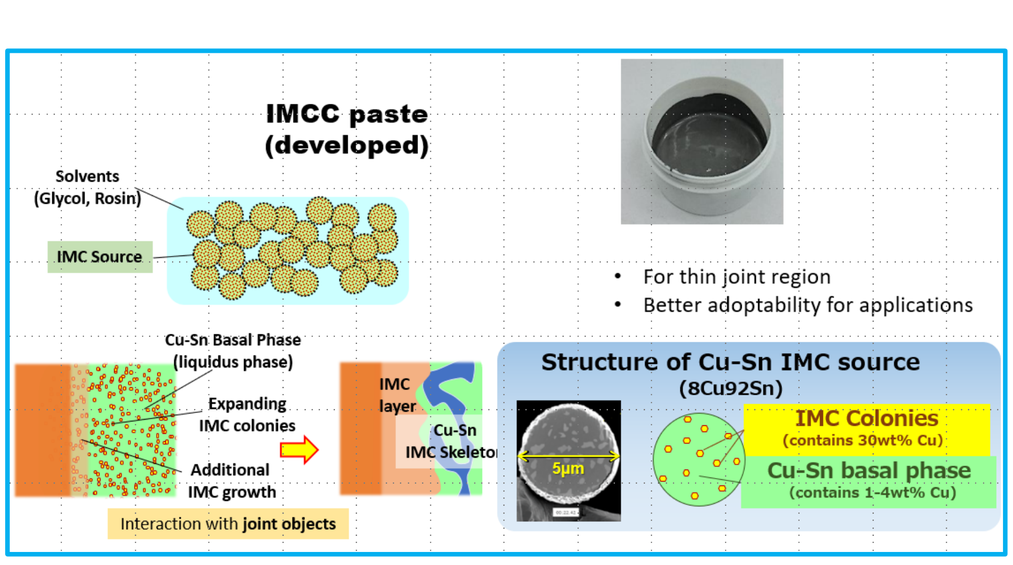


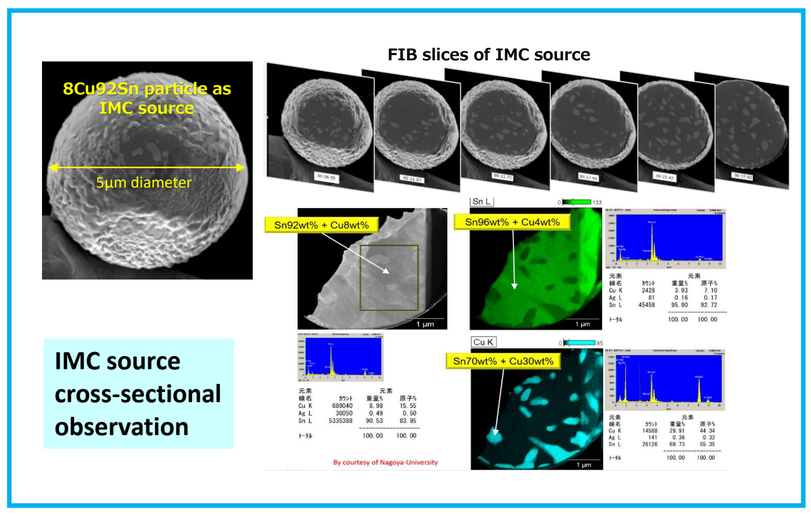
IMCC material Properties	Estimation	By several database*					
	Cu 26wt%	Cu	Sn	Ni	Cu_6Sn_5	Cu_3Sn	SAC305
Young's Modulus (GPa)	10～40	117	41	213	85.56	108.3	31
							41.6
			53				55
CTE (ppm/K)	19～21	17.1	23	12.9	16.3	19	21
			22.3				21.7
Electrical Resistivity (μΩ・cm)	12～15	1.7	11.5	7.8	17.5	8.93	11.4
			12.2				11
Thermal Conductivity (W/m・K)	40～50	398	67	90.5	34.1	70.4	62
			65.7				55

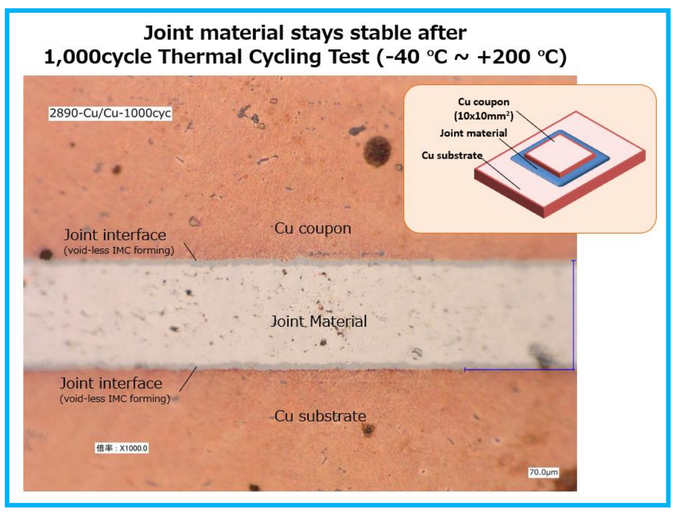
* http://www.geocities.jp/sato5fu/staticmechaprop.htm

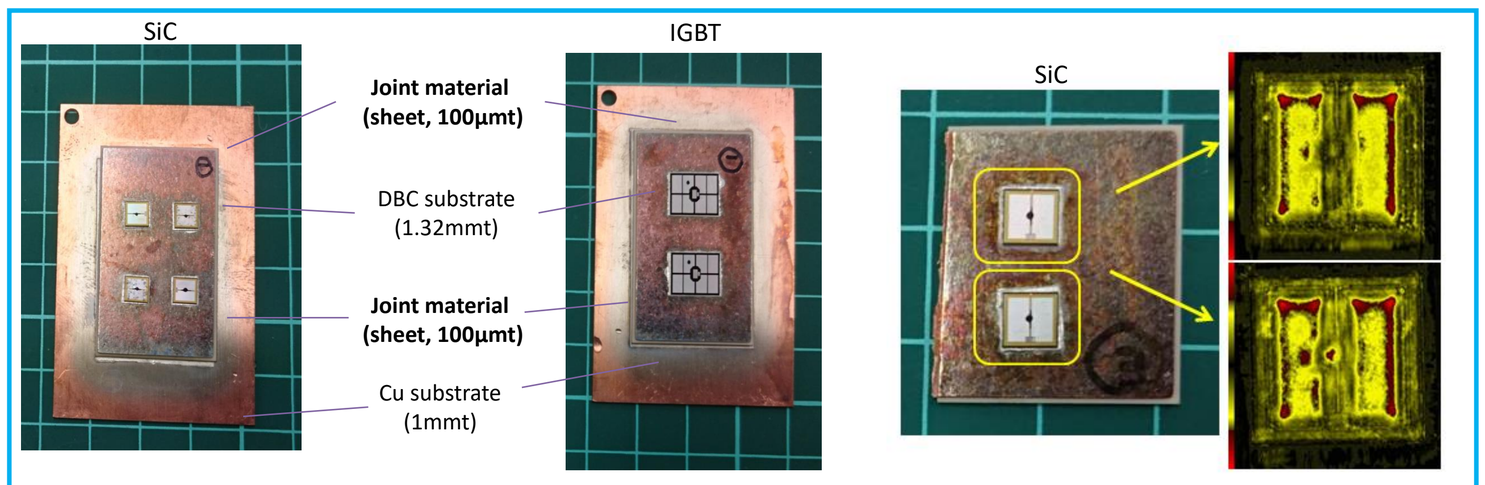








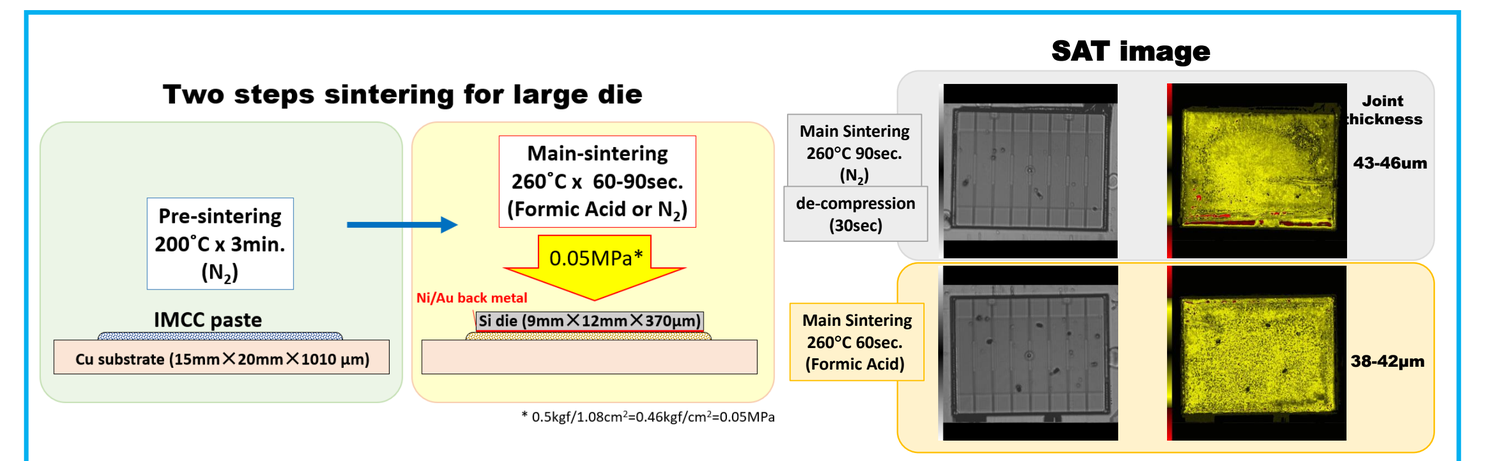




IGBT and SiC joint test by IMCC sheet onto DCB substrate

SN; 171109-6

SN; 171109-7



Large Si die attachment by IMCC paste for thin joint thickness

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