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Supplementary Materials

Investigation of the Thermal Properties of Electrodes on the Film and Its Heating Behavior Induced by Microwave Irradiation in Mounting Processes

Kenji Kanazawa [1], Takashi Nakamura [2], Masateru Nishioka [2] and Sei Uemura [1,*]

[1] Sensing System Research Center, National institute of advanced industrial science and technology (AIST), 1-1-1 Higashi, Tsukuba, Ibaraki 305-8565, Japan; kenji.kanazawa@aist.go.jp

[2] Research Institute for Chemical Process Technology, National institute of advanced industrial science and technology (AIST), 4-2-1, Nigatake, Miyagino-ku, Sendai, 983-8551, Japan; nakamura-mw@aist.go.jp(T.N.); m-nishioka@aist.go.jp (M.N.)

* Correspondence: sei-uemura@aist.go.jp

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Thermal Property of Solder Paste

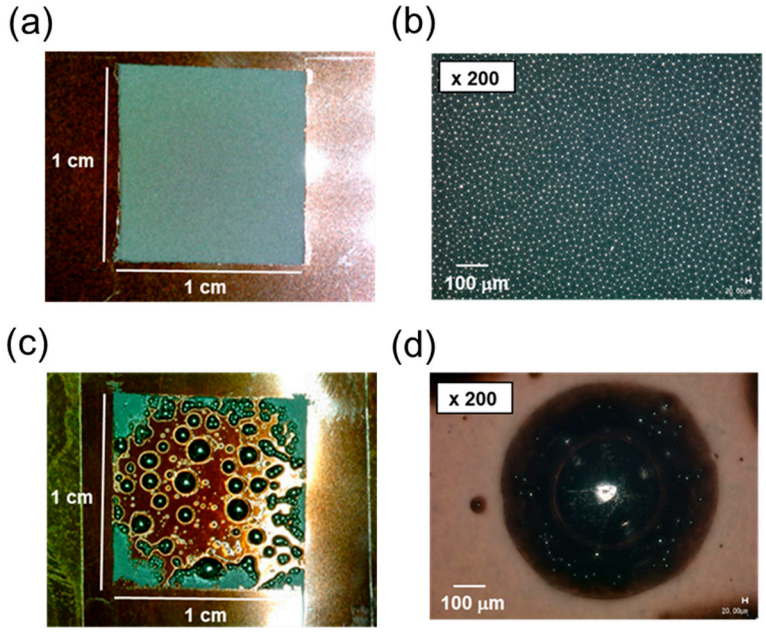

Figure S1. (**a**) A photograph and (**b**) an optical image of solder paste before MW heating process on polyimide sheet. (**c**) A photograph and (**d**) an optical image of solder paste after MW heating process on polyimide sheet.

The melting temperature of the solder past was investigated toward mounting of electric components by melting of solder paste associated with MW heating. Figure S2 shows thermogravimetric (TG) and differential thermal analysis (DTA) curves for the solder paste during heating at a scan rate of 5 °C/min in air. In the DTA curve, a first mass loss at 75–125 °C and a second loss of mass at around 125–175°C can be observed. The first mass loss can be attributed to decomposition of the solvent, because no endothermic or exothermic peak is apparent in the TG curve. The second mass loss can be attributed to the melting of solder, because an apparent endothermic peak appears at around 140 °C in the DTA and differential scanning calorimetry (DSC) curves. In particular, the temperature of the onset temperature at around 139 °C is due to the solidus temperature, while the peak point at around 140 °C is due to the liquidus temperature as shown in inset of Figure S2(b). Furthermore, we found that the sample melted by heating at around 140 °C.

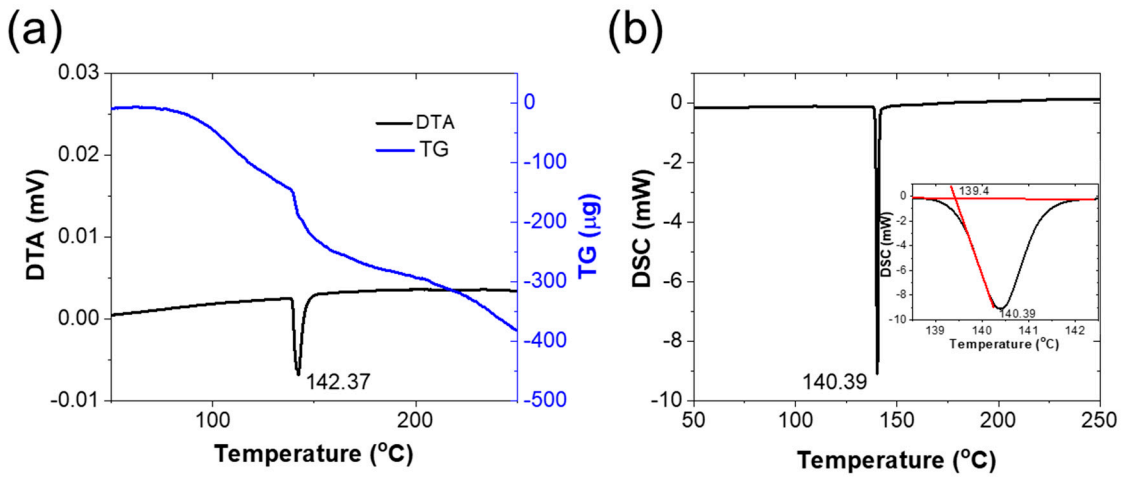

Figure 2. (**a**)TG/DTA and (**b**) DSC curves of solder paste at a scan rate of 5 °C/min in air.

Thermal properties of electrodes with silver paste by MW heating

Table 1. $\triangle T_{(1, 0.5)}$, $\triangle T_{(1, 1)}$, $\triangle T_{(1, 5)}$, $\triangle T_{(1, 10)}$, $\triangle T_{(1, 15)}$, $\triangle T_{(1, 20)}$, $\triangle T_{(0.5, 1)}$, $\triangle T_{(5, 1)}$, $\triangle T_{(10, 1)}$, $\triangle T_{(15, 1)}$, and $\triangle T_{(20, 1)}$ by MW irradiating at 1, 5, 10, 20, 30 W output powers for 30 s. The thickness of the samples is 12 mm.

Output power (W)	△T (°C)											
	(1, Length)[a]						(Width, 1)[a]					
	0.5	**1**	**5**	**10**	**15**	**20**	**0.5**	**1**	**5**	**10**	**15**	**20**
1	0.2	0.2	0.5	0.3	0.8	0.5	0.2	0.2	0.1	0.4	0.6	2.1
5	1.3	1.4	1.1	1.5	1.4	1.3	1.0	1.4	1.3	1.7	2.7	19
10	1.9	1.9	1.7	2.2	2.3	2.6	1.4	1.9	1.6	3.3	4.6	30.5
20	3.6	3.3	3.5	4.4	4.3	5.5	2.6	3.3	2.9	4.8	11.7	46.8
30	6.2	5.3	5.7	8.0	7.7	8.6	4.9	5.3	4.2	11.3	20.7	60.6

[a] Unit of sample width and length are mm.

Simulation data of magnetic field distribution around samples in a TM_{110} cavity using Comsol® software

Table 2. Information about number of elements, meshfree time, and solution time of magnetic field distribution in simulation using Comsol Multiphysics® software.

Electrode size [a] (Width, Length)	Number of Elements	Meshfree time (s)	Solution time (s)
(1, 5)	59,681	4.59	120
(1, 10)	62,759	8.93	143
(1, 15)	64,771	11.56	148
(1, 20)	67,297	11.97	145
(5, 1)	59,391	4.88	90
(5, 10)	62,109	6.98	92
(5, 15)	64,850	8.32	102
(5, 20)	66,950	8.74	96

[a] Unit of sample width and length are mm. The thickness is 8 μm.

Reference

S1. Ma, D.L.; Wu, P. Effects of Zn addition on mechanical properties of eutectic Sn-58Bi solder during liquid-state aging. *Trans. Nonferrous Met. Soc. China* **2015**, *25*, 1225–1233.