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(54) **EMBEDDED CAPACITORS AND METHODS FOR THEIR FABRICATION AND CONNECTION**

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(58) **Field of Classification Search** 361/303; 257/532, 758, 773, E21.008; 438/381, 250

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,346,335 B1	2/2002	Chen et al.	
6,534,133 B1 *	3/2003	Kaloyeros et al.	427/576
6,540,900 B1	4/2003	Kinard et al.	
6,605,314 B2	8/2003	Lessner et al.	
6,744,621 B2	6/2004	Lessner et al.	
6,808,615 B2	10/2004	Lessner et al.	
6,882,544 B2	4/2005	Nakamura et al.	
2004/0256731 A1 *	12/2004	Mao et al.	257/773
2005/0150596 A1 *	7/2005	Vargo et al.	156/324
2005/0217893 A1	10/2005	Noguchi et al.	
2006/0120014 A1	6/2006	Nakamura et al.	

* cited by examiner

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(57) **ABSTRACT**

Embedded capacitors comprise a bimetal foil (500) that includes a first copper layer (205) and an aluminum layer (210) on the first copper layer. The aluminum layer has a smooth side adjacent the first copper layer and a high surface area textured side (215) opposite the first copper layer. The bimetal foil further includes an aluminum oxide layer (305) on the high surface area textured side of the aluminum layer, a conductive polymer layer (420) on the aluminum oxide layer, and a second copper layer (535) overlying the aluminum oxide layer. The bimetal foil may be embedded in a circuit board (700) to form high value embedded capacitors.

5 Claims, 3 Drawing Sheets

