Journal of ASTM International
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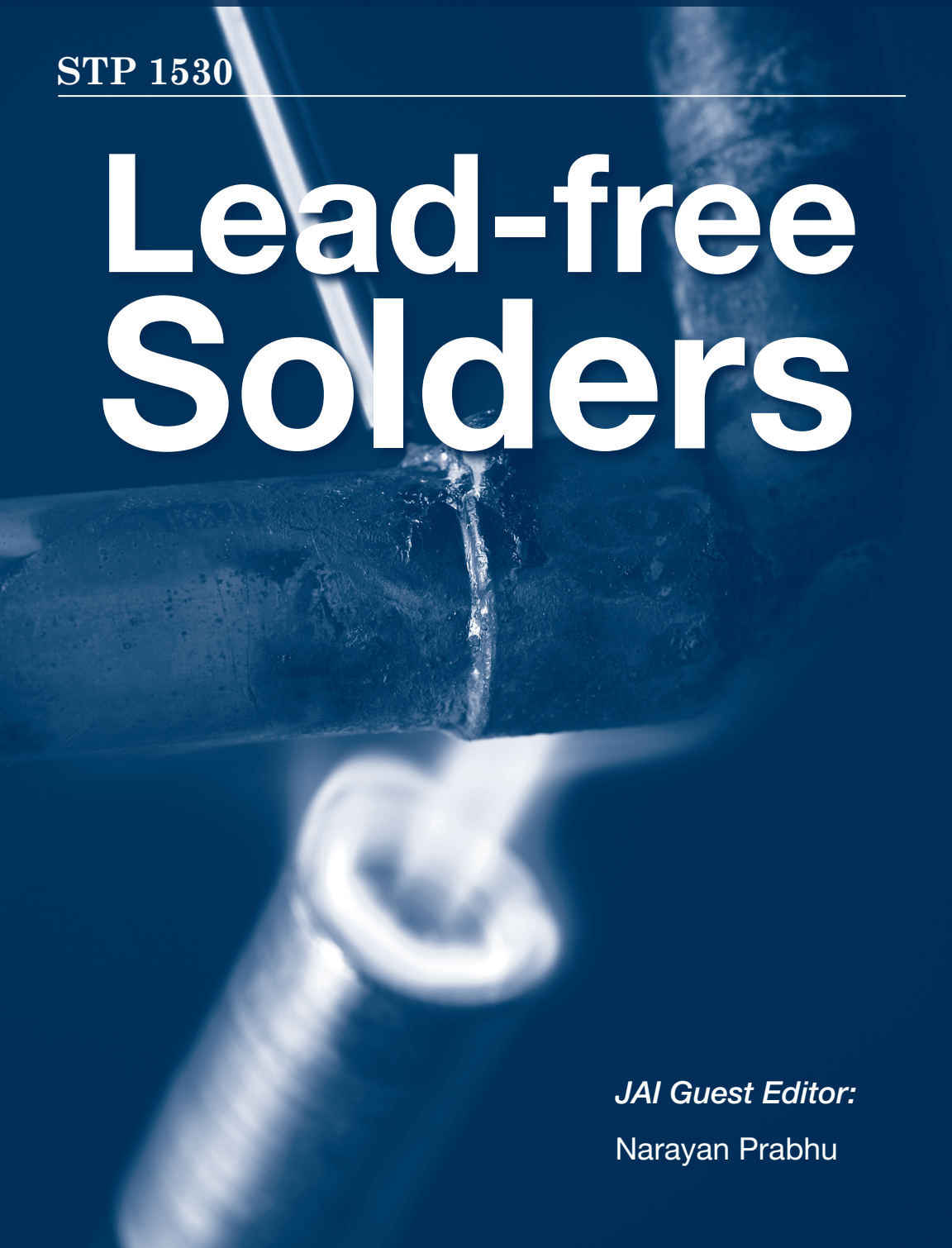
STP 1530

Lead-free Solders



JAI Guest Editor:

Narayan Prabhu

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ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959

Printed in the U.S.A.

ASTM Stock #: STP1530

Library of Congress Cataloging-in-Publication Data
Lead-free solders / JAI guest editor, Narayan Prabu.
p. cm. -- (Journal of ASTM International selected technical papers; STP1530)
Includes bibliographical references and index.
ISBN: 978-0-8031-7516-7 (alk. paper)
1. Lead-free electronics manufacturing processes. 2. Solder and soldering--Materials. I. Prabu, Narayan.
TK7836.L424 2011
621.9'77--dc22 2010053870

Journal of ASTM International (JAI) Scope

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Printed in Bridgeport, NJ
February, 2011

Foreword

THIS COMPILATION OF THE *JOURNAL OF ASTM INTERNATIONAL (JAI)*, STP1530, on *Lead-free Solders*, contains papers published in JAI encompassing the environmental and health concerns of the exposure to lead during soldering and the success and failures of lead-free solders. This STP is sponsored by ASTM Committee D02 on Petroleum Products and Lubricants.

The JAI Guest Editor is Professor K. Narayan Prabhu, Department of Metallurgical & Materials Engineering, National Institute of Technology Karnataka, Surathkal, Mangalore, India.

Contents

Overview

Lead containing solders are used extensively in the electronic packaging industry. The lead based solders have excellent wetting characteristics and provide good electrical, thermal, and mechanical continuities. However the lead present in these solders poses significant environmental hazards, such as the problem of disposal of electronic assemblies, landfill contamination, and toxicity toward human and wild life. To mitigate these problems, a large number of lead free solders have been developed and introduced. Although lead free solders are environmentally friendly, there are several technical issues, such as-wetting, solder joint reliability, solder joint strength, and other mechanical properties, which are not fully resolved. This special issue on lead free solders addresses some of these concerns.

The compendium consists of ten research papers. In the first paper, the factors affecting the wetting behavior of solders and the evolution of interfacial microstructures are reviewed and discussed. The development of Pb-free high temperature solders for power semiconductor devices is reviewed in the second paper. The effect of surface roughness on the wetting behavior and the evolution of microstructures of two lead free solders on copper substrates is discussed in the third paper. A paper by Wang et al. on solder joint reliability compares the fatigue life of SnBi finished thin-small-outline-package (TSOP) parts under thermal cycling to that of Sn finished parts. The paper on microstructural aspects of the ductile-to-brittle transition focuses on specific aspects of the DBTT in the fracture behavior of tin-based lead-free solders. The loading mixity on the interfacial failure mode in a lead-free solder joint is discussed in the sixth paper. The paper by Phil Geng compares the solder joint strengths of BGA (Ball Grid Array) lead-free to that of eutectic lead (Sn–Pb) solder joint strengths. The effect of the morphology of Cu6Sn5 intermetallic compounds on tensile properties of bulk solder and solder joint is discussed in a paper on Tensile properties of Sn-10Sb-5Cu high temperature lead free solder. Empirical modeling and rheological characterization of solder pastes used in electronic assemblies are discussed in the last two papers.

I sincerely thank all the authors for their contributions and sharing their knowledge. I am indebted to the reviewers who have played an important role in the preparation of this STP by their constructive comments and suggestions. I deeply appreciate the timely assistance and the excellent coordination of the review work by ASTM and JAI staff members. It was wonderful working and interacting with them. I am grateful to Dr. George Totten of GE Totten & Associates, LLC, USA who inspired, encouraged, and initiated this work. As guest editor, I earnestly hope that this STP on Lead free Solders will encourage and facilitate further research in the wonderful area of

environmentally friendly lead free solders. This compendium of research papers should serve as a valuable resource for students, researchers, and material scientists in the electronics industry to understand the existing lead-free solders better and initiate the development of newer solders.

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ISBN: 978-0-8031-7516-7
Stock #: STP1530