Ain Shams University
Faculty of Science
Physics department

"Investigation of solid state reactions in Copper-Tin thin film systems"

A Thesis

submitted in partial fulfillment of the requirements for M.Sc. Degree in physics

By

Hanaa Zaka Felfel Gendi

B.Sc. Degree in physics

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Supervisors

Prof.Dr. / Mohamed Medhat Abd El Rahman Hafez

Prof.Dr. / Suzan Mohamed Salah El-Dien Fouad

Prof.Dr. / Dezso Laszlo Beke

To

Department of physics
Faculty of Science
Ain Shams University
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Abassia- Cairo- Egypt- Tel. (202) 26857 769- Fax: 0020224662917- Postal code 11566.
Site: http://Sci.Shams.edu.eg

جامعة عين شمس
كلية العلوم
قسم الفيزياء

" دراسة التفاعلات في الحالة الصلبة لنظم أغشية رقيقة من نحاس- قصدير"

رسالة مقدمة للحصول على درجة الماجستير في العلوم
كجزء مكمل لمتطلبات رسالة الماجستير بكلية العلوم

"الفيزياء"

من
هناء زكا فلفل جندي
بكالوريوس العلوم في الفيزياء
٢٠١٢

لجنة الإشراف

أ٠د/ محمد مدحت عبد الرحمن حافظ
أستاذ فيزياء البصريات – كلية العلوم – جامعة عين شمس
أ٠د/ سوزان محمد صلاح الدين فؤاد
أستاذ فيزياء الجوامد – كلية التربية – جامعة عين شمس
أ٠د/ دجا لاسلو باكا
أستاذ فيزياء الجوامد – كلية العلوم و التكنولوجيا – جامعة ديبرزين بالمجر
إلى
قسم الفيزياء
كلية العلوم- جامعة عين شمس
٢٠١٦

"Investigation of solid state reactions in Copper- Tin thin film systems"

By

Hanaa Zaka Felfel Gendi

Supervisors Signature

Prof.Dr. / M. Medhat

Prof. of optics
Faculty of Science
Ain Shams University

Prof.Dr. / S. S. Fouad

Prof. of solid state
Faculty of Education
Ain Shams University

Prof.Dr. / D. L. Beke

Prof. of solid state
Faculty of Science and Technology
Debrecen University

MEMORANDUM OF AGREEMENT
BETWEEN

AIN SHAMS UNIVERSITY
(CAIRO-EGYPT)

and

UNIVERSITY OF DEBRECEN FACULTY OF SCIENCE AND TECNOLOGY
(DEBRECEN, HUNGARY)

WHEREAS

The representatives of AIN SHAMS UNIVERSITY, CAIRO, EGYPT (ASU) and UNIVERSITY OF DEBRECEN FACULTY OF SCIENCE AND TECHNOLOGY (UD FST), DEBRECEN, HUNGARY

1. Are convinced that cooperation is essential in order to strengthen the relationship between people.
2. Share interests in similar academic, scientific and professional goals.
3. Intend to increase the human and professional relations, which contribute to achieving the aims, which both pursue.

It is therefore agreed:

ARTICLE I

To promote the development of academic, scientific, technical and cultural relations between ASU and UD FST, through not restricted to academic exchanges, scientific research, professional internships and technical cooperation.

ARTICLE II

The two partners agree on achieving cooperation through:

1. Exchange of professors, researchers and students.
2. Exchange of information, curricula, references, research papers and publications. Information shared in this way are to be used exclusively by the parties to enhance their cooperation and must not be disclosed to third parties.
3. Collaboration in joint research projects and joint supervision of MSc and PhD degrees and professional diplomas.

ARTICLE III

- The authority of each party will do its best to secure funds to cover expenses of cooperative activities.
- Such expenses will be agreed upon by both parties before the start of each activity.
- Details about specific actions are to be detailed and signed in a separate agreement based on the present memorandum.

ARTICLE IV

Each party will appoint a coordinator who will be responsible for developing an annual plan for the activation of the agreement.

ARTICLE V

The term of duration will be for two years to be automatically renewed for equal periods unless one of the parties notified in writing to the other of its intent to terminate the agreement at least six months prior the renewal date.

ARTICLE VI

This agreement will become effective immediately upon signing by both parties after the approval of concerned authorities.

ARTICLE VII

In the event of a dispute between the parties arising out or relating this agreement, regarding its interpretation or execution or any other related matter, shall be settled amicably by alternative methods of dispute resolution.

On behalf of
Ain Shams University:

Prof. Dr. Aly Al-Gamal
Dean

Prof. Dr. Suzan Fouad
Coordinator
Department of Physics

Prof. Dr. Hussein Essa
President

On behalf of the
University of Debrecen, Faculty of Science and Technology:

Prof. Dr. Ákos Pintér
Dean

Prof. Dr. Dezső Beke
Coordinator
Department of Solid State Physics

Debrecen 13.06.2014

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Abstract

The problem of solid-state reactions in nanostructured thin film system with individual thicknesses of few nanometers is still a challenging subject. If the films are nanocrystalline, the mass transport along different grain boundaries (GBs) can have an important effect on the entire intermixing process.

Solid state reactions between nanocrystalline Cu and Sn films are investigated at room temperature by depth profiling with secondary neutral mass spectrometry and by X-ray diffraction. A rapid diffusion intermixing is observed leading to the formation of homogeneous Cu_6Sn_5 layer. There is no indication of the appearance of Cu_3Sn phase. This offers a way for solid phase soldering at room temperature, i.e. to produce homogeneous Cu_6Sn_5 intermetallic layer of several tens of nanometers during reasonable time (in the order of hours or less). The growth kinetics and phase formation mechanism of Cu_6Sn_5 are studied. From the detailed analysis of the growth of the planar reaction layer, formed at the initial interface, the value of the parabolic growth rate coefficient at room temperature is estimated. In addition, the overall increase of the composition near to the substrate inside the Cu film is interpreted by grain boundary diffusion induced solid state reaction: the new phase is formed along the grain boundaries and grows perpendicular to the boundary planes. From the initial slope of the composition versus time function, the interface velocity during this reaction is estimated.

Abstract

Copper- tin (Cu-Sn) layers are of great technological and scientific interest, and are frequently used to avoid health and environmental problems caused by the use of lead- based alloys. Sn thin films deposited on Cu- based substrate are often used for soldering of nanoelectronics devices.

Keywords: Cu-Sn nanostructured thin films; growth kinetic studies; SNMS depth profiling; solid state reactions; soldering.

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