

# ATDI

Doctoral School on Material Sciences and Technologies  
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Óbuda  
University

## Semester Report - Autumn 2019

### Creep in soldering materials: Finite element analysis

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# Contents

## ▶ Introduction

- ▶ Semiconductor packaging evolution.
- ▶ Lifetime prediction models.

## ▶ Results

- ▶ Previous semesters.
- ▶ Current semester.

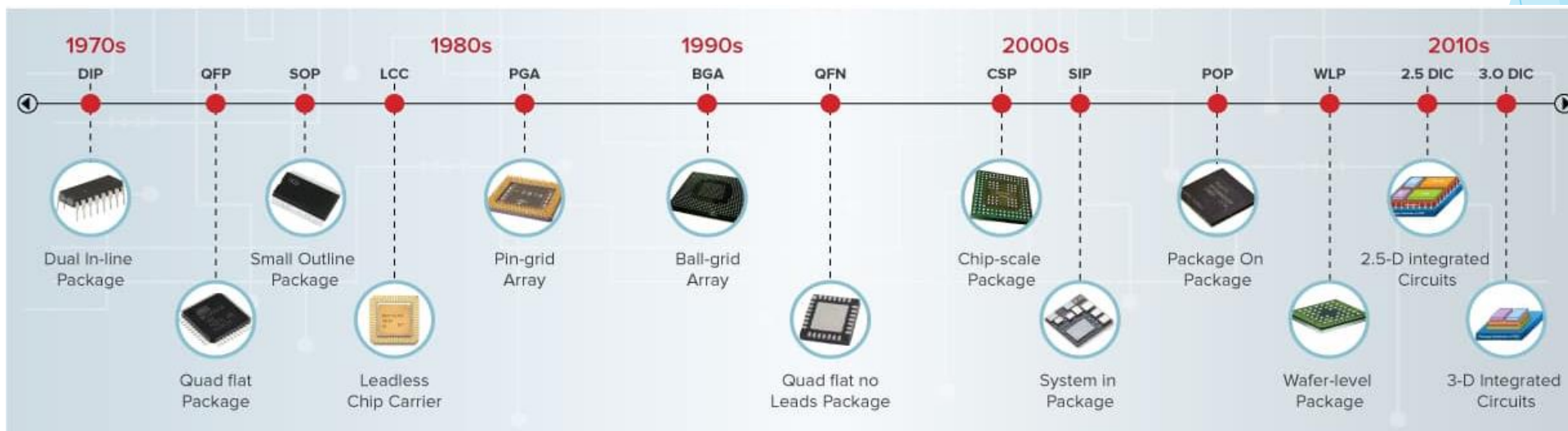
## ▶ Plans for future work

# Introduction

## ► PACKAGING EVOLUTION

### Remark:

- *IC: Integrated Circuit*
- *Electronic Packaging:*
  - Packaging of the integrated circuit chip (die).
  - Interconnections for signal transmission, power and ground.
  - Encapsulation for protecting the chips and interconnections.
  - Heat sinks or other cooling devices needed to remove heat from chips
  - Power supply
  - Housing for electro-magnetic interference (EMI)



# Introduction

## ► LIFETIME MODELS

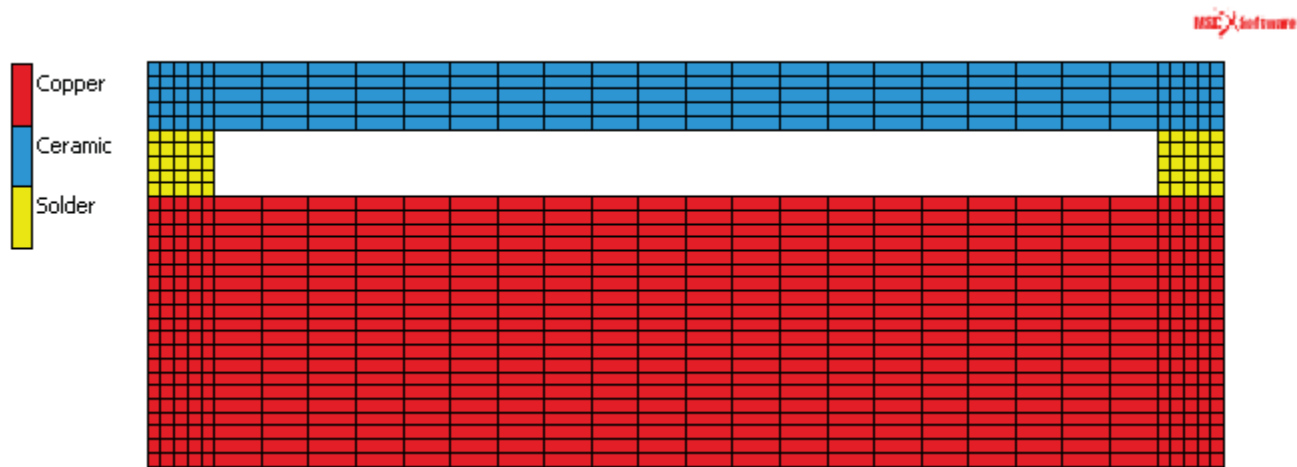
A classification of solder joint fatigue models was proposed by *Lee et al.* in 2000. According to the author, stress-based fatigue model commonly refers to cycling mechanical loads like vibration.

Fatigue Model	Stress	Strain		Energy	Damage	Others
		Plastic	Creep			
Coffin-Manson [14]		×				
Total Strain [15]		×				
Soloman [16]		×				
Engelmaier [16]		×				
Miner [17]		×	×			
Knecht and Fox [18]			×			
Syed [19]			×	×		
Akay [20]				×		
Liang [21]				×		
Heinrich [22]				×		
Pan [23]				×		
Darveaux [24]				×	×	
Stolkarts [25]					×	
Norris and Landzberg [26]						×

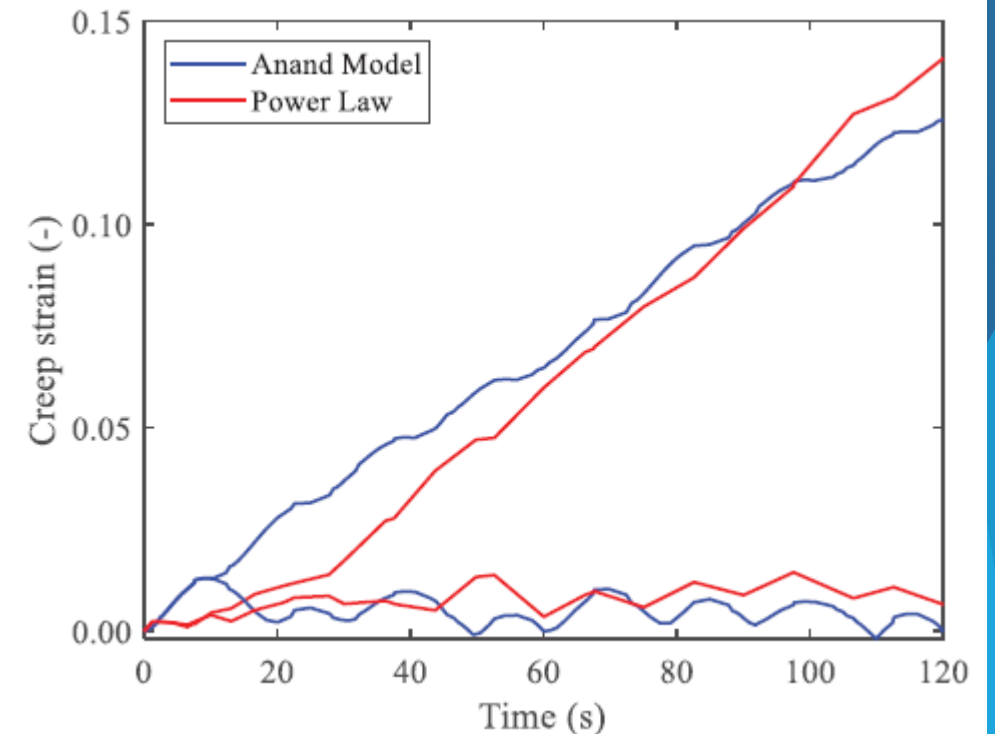
# Results

## PREVIOUS SEMESTERS

Comparison of the thermal-mechanical behavior of a soldered stack influenced by the choice of the solder



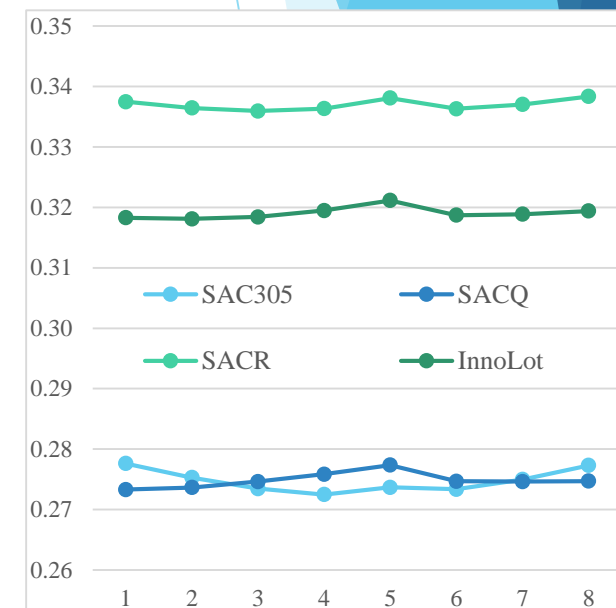
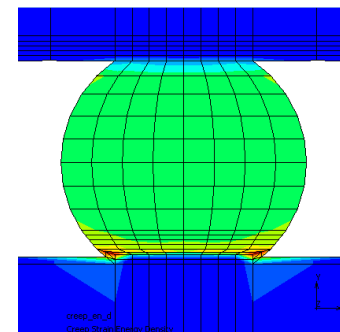
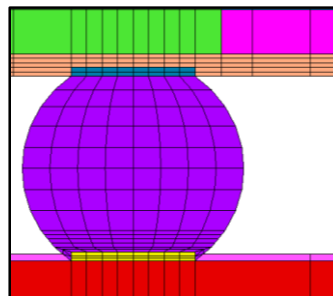
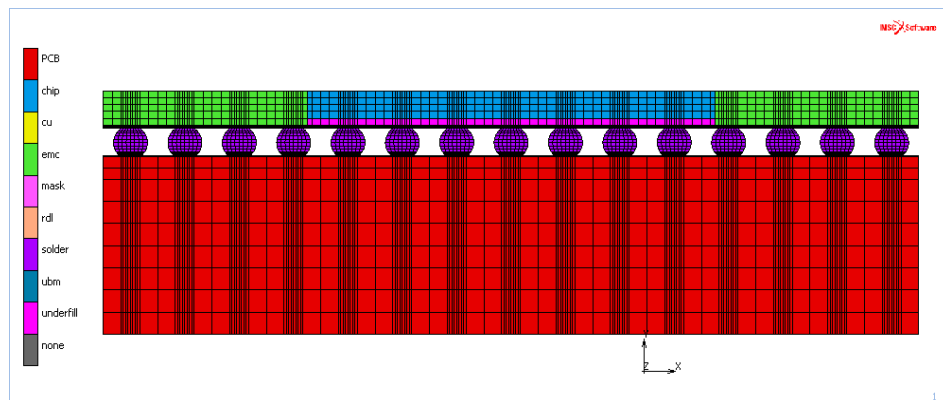
Using the results from the Anand Model, power-law parameters were obtained for SAC305 solder. The accuracy of the results is acceptable with an error of nearly 10% as compared to the simulation values. However, the method used was based on the principle of relative error.



# Results

## ▶ CURRENT SEMESTERS

Solder joint reliability based on creep strain energy density for lead-free solder materials: SAC305, SACQ, SACR, and InnoLot



The following research combines:

- Creep models
- Reliability models.
- Doped SAC Solders (SACX)

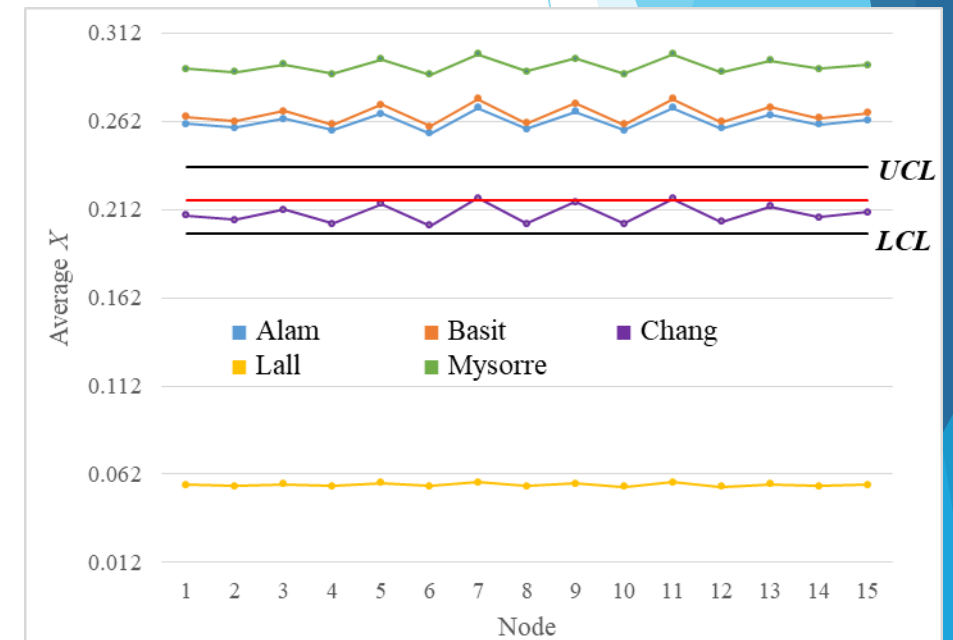
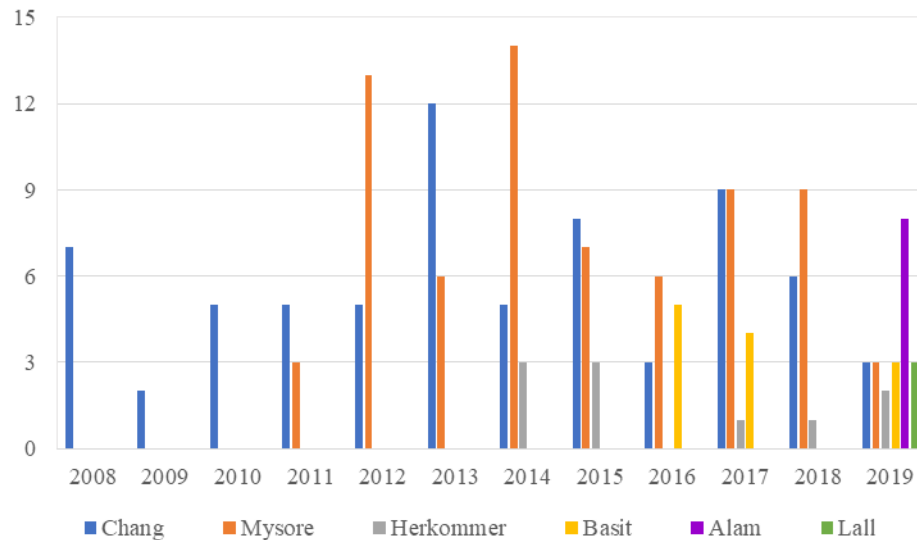
\*there is an inconsistency of data from the simulation as the loadcase increases.

Creep strain energy density range distribution.

# Results

## ▶ CURRENT SEMESTERS

### Statistical assessment of Anand parameters for lead-free solder SAC305



Average Chart

The following research focuses on:

- Average range method.
- Literature review of Solder SAC305

\*Yuwen *et al.* [8] performed a simulation using SAC305 Anand Parameters taken from Wang *et al.* [9]. However, the solder proposed by Wang *et al.* was 95.7Sn3.8Ag0.5Cu (SAC387)

# Results - Courses and Publications

## Courses

Course	Lecturer
Semiconductor Devices	Dr. Horváth Zsolt J.
Characterization Methods of Microelectronic Materials and Devices	Dr. Kovács Balázs

## Publications

**Status:** Published

**Title:** Voltage Supply Assessment Using Process Capability Concepts: A Case Study

**Authors:** A H Vizuite, G J Barbosa, E M Lema, M S Albán, **R S Vargas** and L C Ruiz

**Conference:** IOP Conference Series: Materials Science and Engineering

**Link:** <https://iopscience.iop.org/article/10.1088/1757-899X/559/1/012011>

**Status:** Accepted for publication/Presented in Conference

**Conference:** SIM 2019: 15th International Symposium in Management. Timisoara - RO.

- 3D custom-made eyeglasses frames: an innovative approach to enhance customer satisfaction
- An approach to process standardization in the wood industry: A case study of an Ecuadorian SME



# Future work

**Solder joint reliability based on creep strain energy density for lead-free solder materials: SAC305, SACQ, SACR, and InnoLot**

Solder properties and constants for lifetime prediction based on strain energy and plastic strain must be carried out to compare results. Two central problems have been identified, the lack of information regarding the new SACX solders and the inconsistency of data from the simulation as the time sampling increases.

**Statistical assessment of Anand parameters for lead-free solder SAC305**

Further analysis should be carried out comparing methodologies and simulations performed by all the cited authors.

Thanks for your kind attention

Questions?