

## İLKAY KALAY

Department of Materials Science and Engineering  
Çankaya University, Ankara, TURKEY  
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### EDUCATION

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#### **Ph.D. - Materials Science and Engineering, December 2010**

##### **Iowa State University**

Materials Science and Engineering Department, Ames, IA, USA

Dissertation Title: “*Devitrification Kinetics and Phase Selection Mechanisms in Cu-Zr Metallic Glasses*”

Advisors: Prof. Ralph E. Napolitano and Prof. Matthew J. Kramer

#### **M.S. – Metallurgical and Materials Engineering, January 2004**

##### **Middle East Technical University**

Department of Metallurgical and Materials Engineering, Ankara, Turkey

M. S. Thesis Title: “*Synthesis and Characterization of Zirconium Based Bulk Amorphous Alloys*”

Advisors: Prof. M. Vedat Akdeniz and Prof. Amdulla O. Mekhrabov

#### **B. S. - Metallurgical and Materials Engineering, June 2001**

##### **Middle East Technical University**

Department of Metallurgical and Materials Engineering, Ankara, Turkey

### WORK EXPERIENCE

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#### **Assistant Professor, September 2011-Present**

Materials Science and Engineering Department, Cankaya University

#### **Research/Teaching Assistant, August 2006 – December 2010**

Ames Laboratory of U.S. Department of Energy / Materials Science and Engineering Department, ISU, Ames, IA, USA

#### **Research Scientist, December 2004 – July 2006**

METU Central Laboratory, METU, Ankara, Turkey

## RESEARCH INTERESTS

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- Rapid solidification and metallic glass formation
- Synthesis and characterization of bulk metallic glass nanocomposites
- Development and Characterization of High Entropy Alloys
- Phase selection mechanisms and evolution of structural hierarchy during devitrification
- Phase transformations in rare-earth free magnets
- Development of rare-earth free magnets
- Kinetic modeling, predicting and controlling of devitrification microstructures in glass-forming alloys.
- Characterization Techniques (Analytical electron microscopy (SEM and TEM), X-Ray Scattering (Conventional and Synchrotron X-ray Diffraction))

## THESIS SUPERVISED

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- **Supervisor:** M.S. Thesis Title: Development of High Entropy Alloys For High Temperature Applications, Ayberk Ayrenk, Cankaya University, Micro and Nanotechnology Graduate Program (2019-...)
- **Supervisor:** M.S. Thesis Title: Synthesis and Development of High Entropy Alloys and Their Composites, Selda Küçükyılmaz, Cankaya University, Micro and Nanotechnology Graduate Program
- **Co-Supervisor:** M.S. Thesis Title: Production and Characterization of Zr-Cu-RE Based Bulk Amorphous/Nanocrystal Composite, Fatih Sikan, METU, Metallurgical and Materials Engineering (2015-2017)
- **Co-Supervisor:** M.S. Thesis Title: Development of RE-free MnAl alloys, Ozgun Acar, METU, Metallurgical and Materials Engineering (2014-2016)

## PROJECTS

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1. **Principal Investigator, TUBİTAK 3501 (117M295)** “Samaryum Katkılı Bakır-Zirkonyum-Aluminyum Bazlı Metalik Cam ve Nanokompozitlerinin Üretilmesi ve Geliştirilmesi”, (OCT 2017- OCT 2019)
2. **Principal Investigator**, ““The Local Structure and Chemistry in Marginal Glass Forming Alloys”, AFOSR’s (The Air Force Office of Scientific Research, U.S.A.) BAA Topic: Aerospace Materials for Extreme Environments, (MAR 2017-MAR 2020)
3. **Researcher**, U.S. Department of Energy Projects AL-90-501-002; “Structure and Chemistry in Condensed Systems”, (2008-2010).
4. **Researcher**, Advanced Photon Source, Argonne National Laboratory; “Time resolved phase transitions in Al and Zr based model alloy systems”, 2007.
5. **Researcher**, METU BAP-2002-07-02-00-108; “Synthesis and Characterization of Zirconium Based Bulk Amorphous Alloys”, (2002-2004)

## PROFESSIONAL ACTIVITIES

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- **Congress Session Coordinator and Chair**, International 17<sup>th</sup> International Metallurgy & Materials Congress, September 2014.
- **Advisory Committee and Editorial Board**, 7<sup>th</sup> Engineering and Technology Symposium, May 2014 and 6<sup>th</sup> Engineering and Technology Symposium, April 2013, Çankaya University.
- **Panelist**, TUBITAK, 1001 and 3501 projects.
- **Project Review Expert**, KOSGEB, Research and Development & Innovation and Industrial Application Support Program
- **Reviewer** for peer reviewed journal, Journal of Non-Crystalline Solids, Thin Solid Films, Materials Chemistry and Physics, Materials Science and Technology
- Student Member, Materials Advantage (TMS, AIST, ACerS, ASM Int.).
- METU and ISU Alumni Associations.

## ACADEMIC SERVICES

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- Çankaya University, Nanotechnology Research Laboratory Coordinator
- MSE Department, Summer Internship Committee (Head)
- MSE Department, Industrial and Occup. Relations Committee (Head)
- MSE Department, Errors and Appeals Committee (Head)
- MSE Department, Accreditation Committee
- MSE Department, Education Committee (Undergraduate/Graduate)
- MSE Department, Erasmus Committee
- MSE Department, Laboratory Development Committee
- MSE Department, Strategic Planning Committee
- MSE Department, Lateral and Vertical Transfers Committee
- Academic Advisor of Materials Science and Nanotechnology Group
- Student Mentoring, Iowa State University, Ames, USA, 2008
- Volunteer judge in Iowa State Science and Technology Fair, Ames, IA, USA, 2008 and 2009.

## AWARDS

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- **Paper was featured on Advances in Engineering (January 2016)**, I Kalay, R.E. Napolitano, M.J. Kramer, “*Crystallization Kinetics and Phase Transformation Mechanism in Cu<sub>56</sub>Zr<sub>44</sub> glassy alloy*”, Metallurgical and Materials Transactions A-Physical Metallurgy and Materials Science, Physical Metallurgy and Materials Science, vol. 46, issue 8, pp. 3356-3364, 2015.
- **BEST POSTER AWARD**, “Phase Selection in Cu-Zr Metallic Glasses”, TMS 2015 144<sup>th</sup> Annual Meeting & Exhibition (Florida/U.S.A.), **March 2015**.

- **Paper was featured on Advances in Engineering (March 2013)**, Y. E. Kalay, I. Kalay, J. Hwang, P.M. Voyles, M. J. Kramer, “*Local Chemical and Topological Order in Al-Tb and its Role in Controlling Nanocrystal Formation*”, Acta Materialia, vol. 60, issue 3, p. 994-1003, February 2012.
- **Paper was highlighted by Physical Review Letters (May 2012)**, J. Hwang, Z. H. Melgarejo, Y. E. Kalay, I. Kalay, M. J. Kramer, D. S. Stone, P. M. Voyles, “*Nanoscale structure and structural relaxation in Zr50Cu45Al5 bulk metallic glass*”, Physical Review Letters, vol. 108, issue 19, p. 195505-195510, May 2012.

## TEACHING EXPERIENCE

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### Assistant Professor, Çankaya University, (September 2011-Present)

Materials Science and Engineering Department

### COURSES TAUGHT

Academic Year	Semester	Course Code	Course Name	Hours/week	
				Theoretical	Lab/Recitation
2018-2019	Fall	MNT 508	Structure and Analysis of Materials/Nanomaterials	3	0
		MSE 409	Phase Transformations	3	0
		MSE 407	Innovative Engineering Analysis and Design	2	1
		MSE 307	Materials Characterization II	3	2
		MSE 225	Introduction to Materials Science (2 sections)	3	2
2017-2018	Spring	MSE 408	Innovative Engineering Design and Implementation	2	1
		MSE 324	Casting and Solidification	3	0
		MSE 226	Engineering Materials (2 sections)		
		MSE 204	Thermodynamics and Phase Equilibria	4	0
2017-2018	Fall	MSE 409	Phase Transformations	3	0
		MSE 407	Innovative Engineering Analysis and Design	2	1
		MSE 307	Materials Characterization II	3	2
		MSE 225	Introduction to Materials Science (2 sections)	3	2
2016-2017	Spring	MSE 408	Innovative Engineering Design and Implementation	2	1
		MSE 324	Casting and Solidification	3	0
		MSE 226	Engineering Materials (2 sections)	3	0
2016-2017	Fall	MSE 409	Phase Transformations	3	0
		MSE 407	Innovative Engineering Analysis and Design	2	1
		MSE 307	Materials Characterization II	3	2
		MSE 225	Introduction to Materials Science	3	2
2015-2016	Fall	MSE 409	Phase Transformations	3	0

		MSE 407	Innovative Engineering Analysis and Design	2	1
		MSE 307	Materials Characterization II	3	2
		MSE 203	Introduction to Thermodynamics	3	0
		MSE 225	Introduction to Materials Science	3	2
2014-2015	Spring	MSE 324	Casting and Solidification	3	0
		MSE 204	Thermodynamics and Phase Equilibria	4	0
		MSE 125	Materials Science and General Chemistry	3	2
2014-2015	Fall	MSE 307	Materials Characterization II	3	2
		MSE 203	Introduction to Thermodynamics	3	0
		MSE 225	Introduction to Materials Science	3	2
2013-2014	Spring	MSE 204	Thermodynamics and Phase Equilibria	4	0
		MSE 125	Materials Science and General Chemistry	3	2
		CHEM 104	Chemistry for Engineering II	3	2
2013-2014	Fall	MSE 201	Materials Science I	3	1
		CHEM 103	Chemistry for Engineering I (3 sections)	3	2
2012-2013	Summer	MSE 125	Introduction to Materials Science	3	2
2012-2013	Spring	MSE 125	Materials Science and General Chemistry	3	2
		MSE 104	Chemistry for Engineering II	3	2
		MSE 102	Materials Science and Engineering Orientation	2	0
2012-2013	Fall	MSE 103	Chemistry for Engineering I (3 sections)	2	2
2011-2012	Fall	MSE 103	Chemistry for Engineering I	2	2

### **Teaching Assistant, Iowa State University (2006-2010)**

Assisted sophomore students in thermal analyses laboratory.

### **Thermal Analyses Laboratory**

Supply hands-on user trainings for undergraduate graduate students and postdocs in thermal analyses laboratory. Prepared standard operating procedures (SOPs) for the instruments.

## **PUBLICATIONS**

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- F. Sikan, S.E. Atabay, A. Motallebzadeh, S. Özerinç, **I. Kalay**, Y.E. Kalay, “Effect of Sm on Thermal and Mechanical Properties of Cu-Zr-Al Bulk Metallic Glasses”, Materials Science and Engineering A, vol. 743, pp. 168-174, 2019.
- F.Sikan, B. Yasar, **I. Kalay**, "Nanocrystallization in Cu-Zr-Al-Sm Bulk Metallic Glasses”, Metallurgical and Materials Transactions A: Physical Metallurgy and Materials Science, vol. 49, issue 4, pp. 1328-1335, 2018.

- **I Kalay**, R.E. Napolitano, M.J. Kramer, “*Crystallization Kinetics and Phase Transformation Mechanism in Cu<sub>50</sub>Zr<sub>44</sub> glassy alloy*”, Metallurgical and Materials Transactions A-Physical Metallurgy and Materials Science, Physical Metallurgy and Materials Science, vol. 46, issue 8, pp. 3356-3364, **2015**.\*  
\* **Paper was featured on Advances in Engineering (January 2016)**
- T. E. Cullinan, **I Kalay**, Y.E. Kalay, R.E. Napolitano, M.J. Kramer, “*Kinetics and Mechanisms of Isothermal Devitrification in Amorphous Cu<sub>50</sub>Zr<sub>50</sub>*”, Metallurgical and Materials Transactions A-Physical Metallurgy and Materials Science, vol. 46, issue 2, pp. 600-613, **2015**.
- J. Hwang, Z. H. Melgarejo, Y. E. Kalay, **I. Kalay**, M. J. Kramer, D. S. Stone, P. M. Voyles, “*Nanoscale structure and structural relaxation in Zr<sub>50</sub>Cu<sub>45</sub>Al<sub>5</sub> bulk metallic glass*”, Physical Review Letters, vol. 108, issue 19, p. 195505-195510, 2012. \*\*  
\*\* **Paper was highlighted by Physical Review Letters (May 2012)**
- Y. E. Kalay, **I. Kalay**, J. Hwang, P.M. Voyles, M. J. Kramer, “*Local Chemical and Topological Order in Al-Tb and its Role in Controlling Nanocrystal Formation*”, Acta Materialia, vol. 60, issue 3, p. 994-1003, 2012. \*\*\*  
\*\*\* **Paper was featured on Advances in Engineering (March 2013)**
- **I. Kalay**, M.J. Kramer, R.E. Napolitano, “*High-accuracy X-ray diffraction analysis of phase evolution sequence during devitrification of Cu<sub>50</sub>Zr<sub>50</sub> metallic glass*”, Metallurgical and Materials Transactions A-Physical Metallurgy and Materials Science, 42A, issue 5, p.1144-1153, 2011.
- F. Sıkan, **I. Kalay**, Y. E. Kalay, “*Sm Microalloyed Cu-Zr-Al Bulk Metallic Glasses*”, 18th International Metallurgy & Materials Congress, UCEAT Chamber of Metallurgical Engineers, September 2016, Istanbul, Türkiye, Congress e-Book, p. 424-427.
- **I. (Saltoglu) Kalay**, M. V. Akdeniz and A. O. Mekhrabov, “*Synthesis and Characterization of Zirconium Based Bulk Amorphous Alloys*”, 12th International Metallurgy & Materials Congress, UCEAT Chamber of Metallurgical Engineers, September 2005, Istanbul, Türkiye, Congress e-Book, p. 1103-1109.
- **I. (Saltoglu) Kalay**, A. O. Mekhrabov and M. V. Akdeniz, “*Prediction of Bulk Glass Forming Ability in Zirconium Based Multicomponent Alloy Systems*”, 12th International Metallurgy & Materials Congress, UCEAT Chamber of Metallurgical Engineers, September 2005, Istanbul, Türkiye, Congress e-Book, p. 2078-2085.

## CONFERENCE TALKS

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1. B. Yasar, I. Kalay, Y.E. Kalay, “The Influence of Liquid Structure on the Devitrification of Solid Amorphous Al-based Marginal Glass Forming Alloys”, TMS 147<sup>th</sup> Annual Meeting & Exhibition, Phoenix, AZ, U.S.A, MAR 2018.
2. F. Sıkan, **I. Kalay**, S. Özerinç, Y. E. Kalay “*Effect of Sm Micro-alloying on the Mechanical Behavior and Crystallization Kinetics of Cu-Zr-Al BMGs*”, TMS 146<sup>th</sup> Annual Meeting & Exhibition, San Diego, CA, U.S.A, February 2017.
3. A.M. Genc, O. Acar, **I. Kalay**, Y.E. Kalay, “*Microstructural Characterization of Magnetic MnAl Alloys*”, TMS 146<sup>th</sup> Annual Meeting & Exhibition, San Diego, CA, U.S.A, February 2017.
4. A.M. Genc, O. Acar, **I. Kalay**, Y.E. Kalay, “*The Kinetics of Ferromagnetic Tau Phase Formation in Mn-Al Alloys*”, TMS 146<sup>th</sup> Annual Meeting & Exhibition, San Diego, CA, U.S.A, February 2017.
5. F. Sıkan, **I. Kalay**, Y. E. Kalay, “*Sm Microalloyed Cu-Zr-Al Bulk Metallic Glasses*”, 18<sup>th</sup> International Metallurgy-Materials Congress and Fair, Istanbul, Turkey, September 2016.
6. F. Sıkan, **I. Kalay**, Y. E. Kalay , “*Characterization of Glassy and Partially Crystalline Cu-Zr-Al-Sm Metallic Glasses*”, TMS 145<sup>th</sup> Annual Meeting & Exhibition, Nashville, TN, U.S.A, February 2016.
7. O. Acar, M. Genc, **I. Kalay**, Y. E. Kalay, “*Characterization of Mn-Al Magnetic Alloys*”, TMS 144<sup>th</sup> Annual Meeting & Exhibition, Orlando, FL, U.S.A, March 2015.
8. **I. Kalay**, Y. E. Kalay, M. J. Kramer, R. E. Napolitano, “*Crystallization Mechanisms and Structural Relaxation in Cu-Zr Metallic Glasses*”, TMS, San Diego, CA, USA, February 2014.
9. **I. Kalay**, Y. E. Kalay, M. J. Kramer, R. E. Napolitano, “*Phase Selection and Transformation Mechanisms and Devitrification Kinetics in Cu-Zr Based Metallic Glasses*”, **21. Ulusal Elektron Mikroskopi Kongresi (Uluslararası katılımlı)**, Mersin, Turkey, May 2013.
10. **I. Kalay**, Y. E. Kalay, M. J. Kramer, R. E. Napolitano, “*Devitrification Kinetics and Phase Selection Mechanisms in Cu-Zr Metallic Glasses*”, TMS, San Antonio, TX, USA, March 2013.
11. P. Voyles, J. Hwang, Z. Melgarejo, D. Stone, **I. Kalay**, M. Kramer, “*Structure and Relaxation of Zr-Cu-Al Bulk Metallic Glass from Hybrid Reverse Monte Carlo Modeling of Fluctuation Electron Microscopy Data*”, TMS, Orlando, FL,

USA, March 2012.

12. Y.E. Kalay, T. Demirtas, **I. Kalay**, J. Hwang, P.M. Voyles, R.E. Napolitano, M.J. Kramer “*Effects of Local Chemical and Topological Ordering in Controlling Nanocrystal Formation in Al-Rare Earth (RE) Alloys*”, **THERMEC**, Quebec, Canada, August 2011. (**INVITED**)
13. J. Hwang, Y. E. Kalay, **I. Kalay**, M. J. Kramer, P. M. Voyles, “*Structure of Zr Bulk Metallic Glasses Constrained at Short and Medium Range*”, **GOMD**, Savannah, GA, May 2011.
14. J. Hwang, Y. E. Kalay, **I. Kalay**, M. J. Kramer, P. M. Voyles, “*Reverse Monte Carlo Modeling of Fluctuation Electron Microscopy Data*”, **GOMD**, Savannah, GA, May 2011.
15. **I. Kalay**, Y. E. Kalay, M. J. Kramer, R. E. Napolitano, “*Devitrification Kinetics and Phase Selection Mechanisms in Cu-Zr*”, **TMS**, San Diego, CA, USA, February 2011.
16. J. Hwang, Y. E. Kalay, **I. Kalay**, M. J. Kramer, P. M. Voyles, “*Nanometer scale structural fluctuation in Zr-based bulk metallic glass*”, **MRS**, Boston, MA, September 2010.
17. **I. Kalay**, Y.E. Kalay, M.J. Kramer, and R.E. Napolitano “*Crystallization Mechanism in Amorphous Cu-Zr*”, **TMS**, Seattle, WA, USA, February 2010.
18. **I. Kalay**, “*Devitrification Kinetics and Phase Selection Mechanism in Amorphous Cu-Zr System*”, **MRS Student Seminar Series**, Iowa State University, 2010.
19. R. E. Napolitano, **I. Kalay**, M. J. Kramer, “*Devitrification in Cu-Zr Binary Metallic Glasses: Energetics, Structure, And Dynamics*”, **THERMEC**, Berlin, Germany, August 2009. (**INVITED**)
20. **I. Kalay**, Y. E. Kalay, M. J. Kramer, “*Devitrification in Cu-Zr Binary Metallic Glasses: Energetics, Structure, And Dynamics*”, **MS&T**, Pittsburgh, PA, USA, October 2008.
21. **I. (Saltoglu) Kalay**, M. V. Akdeniz, O. A. Mekhrabov, “*Synthesis and Characterization of Zirconium Based Bulk Amorphous Alloys*”, 12<sup>th</sup> **International Metallurgy-Materials Congress and Fair**, Istanbul, Turkey, 2005.



## POSTER PRESENTATIONS

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1. O. Acar , A.M. Genc, O. Acar, Y.E. Kalay, **I. Kalay**, “*Investigation Phase Transformation Route in Mn-Al Alloys*”, TMS 146<sup>th</sup> Annual Meeting & Exhibition, San Diego, CA, U.S.A, February 2017.
2. F. Sıkan, **I. Kalay**, Y. E. Kalay, “*Nanocrystallization in Cu-Zr-Al-Sm Metallic Glasses*”, TMS 146<sup>th</sup> Annual Meeting & Exhibition, San Diego, CA, U.S.A, February 2017.
3. **I. Kalay**, Y.E. Kalay, M.J. Kramer, “*Phase Selection in Cu-Zr Metallic Glass*”, TMS 144<sup>th</sup> Annual Meeting & Exhibition, Orlando, FL, U.S.A, March 2015.  
**(BEST POSTER AWARD)**
4. **I. Kalay**, F. Sıkan, Y. E. Kalay, “*Development of Cu-Zr-Al-RE (Rare Earth) Bulk Metallic Glasses*”, TMS 144<sup>th</sup> Annual Meeting & Exhibition, Orlando, FL, U.S.A, March 2015.
5. O. Acar, **I. Kalay**, Y. E. Kalay, “*Development of Mn-Al-Ti Permanent Magnet Alloys*”, TMS 143<sup>th</sup> Annual Meeting & Exhibition, San Diego, CA, USA, February 2014.
6. **I. Kalay**, Y.E. Kalay, M.J. Kramer, L.S. Chumbley, I.E. Anderson, and R.E. Napolitano “*Structural and Chemical Characterization at Nanoscales*”, **Workshop on Micro-XRF Analysis of Chemically Complex Materials**, Ames Laboratory, Ames, IA, USA, 2010.
7. Y.E. Kalay, **I. Kalay**, M.J. Kramer, R.E. Napolitano, S.H. Zhou “*Control of nanoscale crystallization dynamics and non-equilibrium structures in glass-forming metallic systems*”, **Structure and Dynamics in Condensed Systems**, Ames Laboratory, Ames, IA, USA, 2009.
8. **I. Kalay**, Y.E. Kalay, M.J. Kramer, and R.E. Napolitano, “*Crystallization Kinetics and Thermal Stability of Amorphous Cu<sub>50</sub>Zr<sub>50</sub>*”, TMS, San Francisco, CA, USA, 2009.
9. R. Craft, A. Bauer, **I. Kalay**, R.E. Napolitano, “*Devitrification Kinetics in La<sub>55</sub>Al<sub>25</sub>Cu<sub>10</sub>Ni<sub>10</sub> Bulk Metallic Glass*”, **Undergraduate Student Poster Presentation**, Iowa State University, 2009.
10. **I. (Saltoglu) Kalay**, M. V. Akdeniz, O. A. Mekhrabov, “*Prediction of Bulk Glass Forming Ability in Zirconium Based Multicomponent Alloy Systems*”, **12<sup>th</sup> International Metallurgy-Materials Congress and Fair**, Istanbul, Turkey, 2005.

## TECHNICAL SKILLS

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### Electron Microscopy

Scanning Electron Microscopy:

- JEOL JSM 6060 LV, and JSM 5910 LV.

Transmission Electron Microscopy

### X-ray Scattering

- High energy synchrotron X-ray diffraction, conventional powder diffraction
- Rietveld structure refinement (GSAS, Rietica)

### Thermal Analyses

- Differential Scanning Calorimeter (DSC)
- Simultaneous Thermogravimetric Analyzer and Differential Thermal Analyzer (TG/DTA)
- Thermogravimetric Analysis and Fourier Transform Infrared Spectrometer System (TGA/FTIR)
- Dynamic Mechanical Analyzer (DMA)
- Thermomechanical Analyzer (Dilatometer) (TMA)
- Thermal Conductivity Probe.

### Mechanical Testing

- Tensile testing, micro/macro hardness testing, impact testing– Instron and Leco inst.).
- Metallography and failure analysis.

### Alloy Production Techniques

- Experienced on alloy production using vacuum arc melting/casting furnaces, free-jet (Cu-wheel) melt-spinning, centrifugal casting and heat treatment.

### Software

- Microscopy and Image Analysis

GATAN Digital Micrograph, ES Vision, Desktop Microscopist, Carine, ImageJ, Image-Pro, etc.

## WORKSHOPS - TRAINING PROGRAMS

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- “**3mes, Materials and Metallurgy Engineering Education Symposium**”, Anadolu University, November 2013.
- **Advanced Thermal Analysis Thermophysical Properties Workshop**, NETZSCH, St.Paul, MN, USA, 2009.
- **Radiological Worker Training**, Ames, IA, USA, 2009.
- **Chemical Hygiene Plan and Personal Protective Equipment for Laboratory Employees**, Ames, IA, USA, 2006.
- **General Safety Training for Laboratory Employees**, Ames, IA, USA, 2006.
- **Test Laboratory Accreditation**, METU, Ankara, Turkey, 2005.

## LINGUISTICS

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- English (Advanced)
- Spanish (beginner)
- German (beginner)