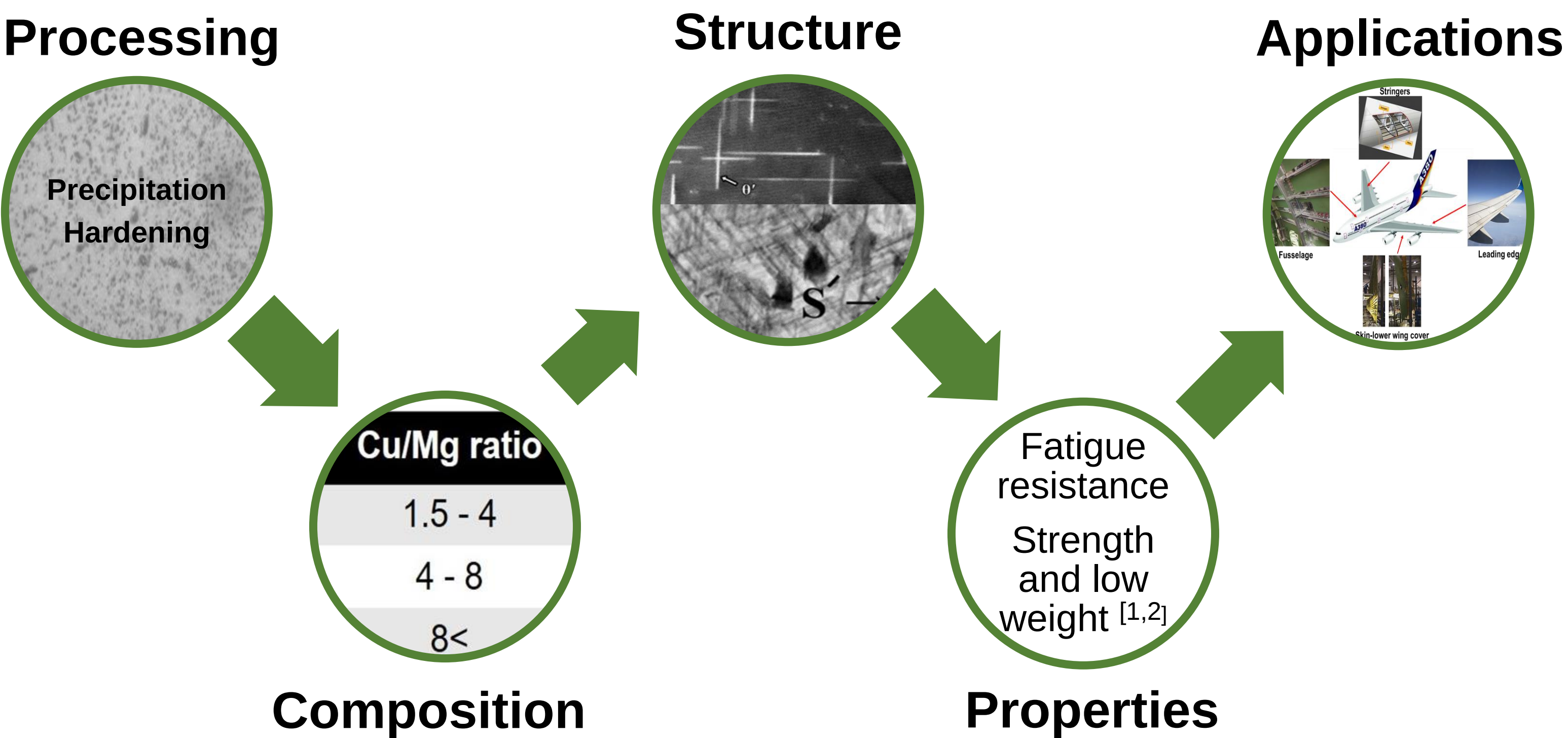


Correlation between activation energy and cold rolled on the formation of S' phase in Al₂₀₂₄ Alloy

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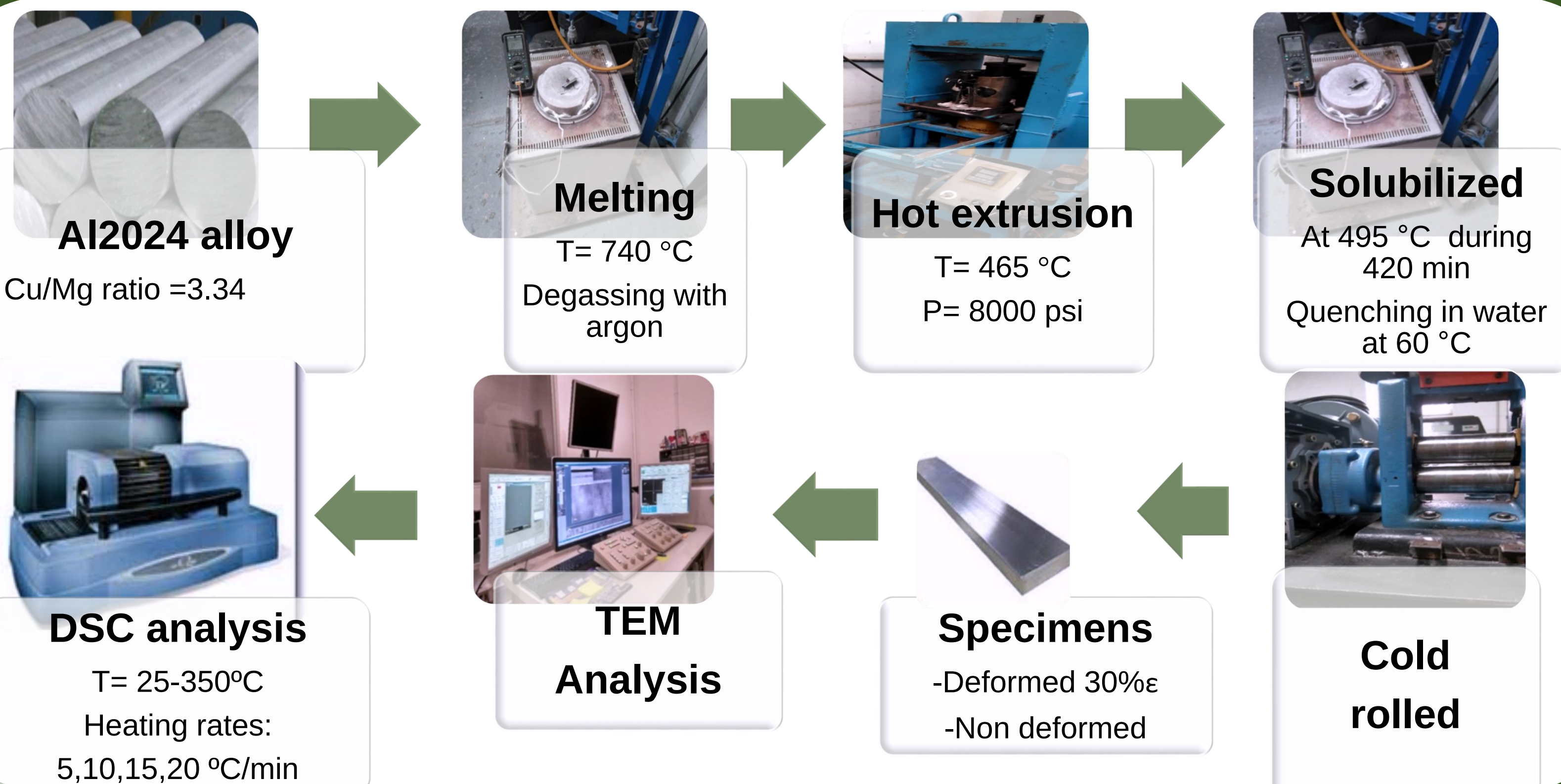
1. INTRODUCTION



2. OBJETIVES

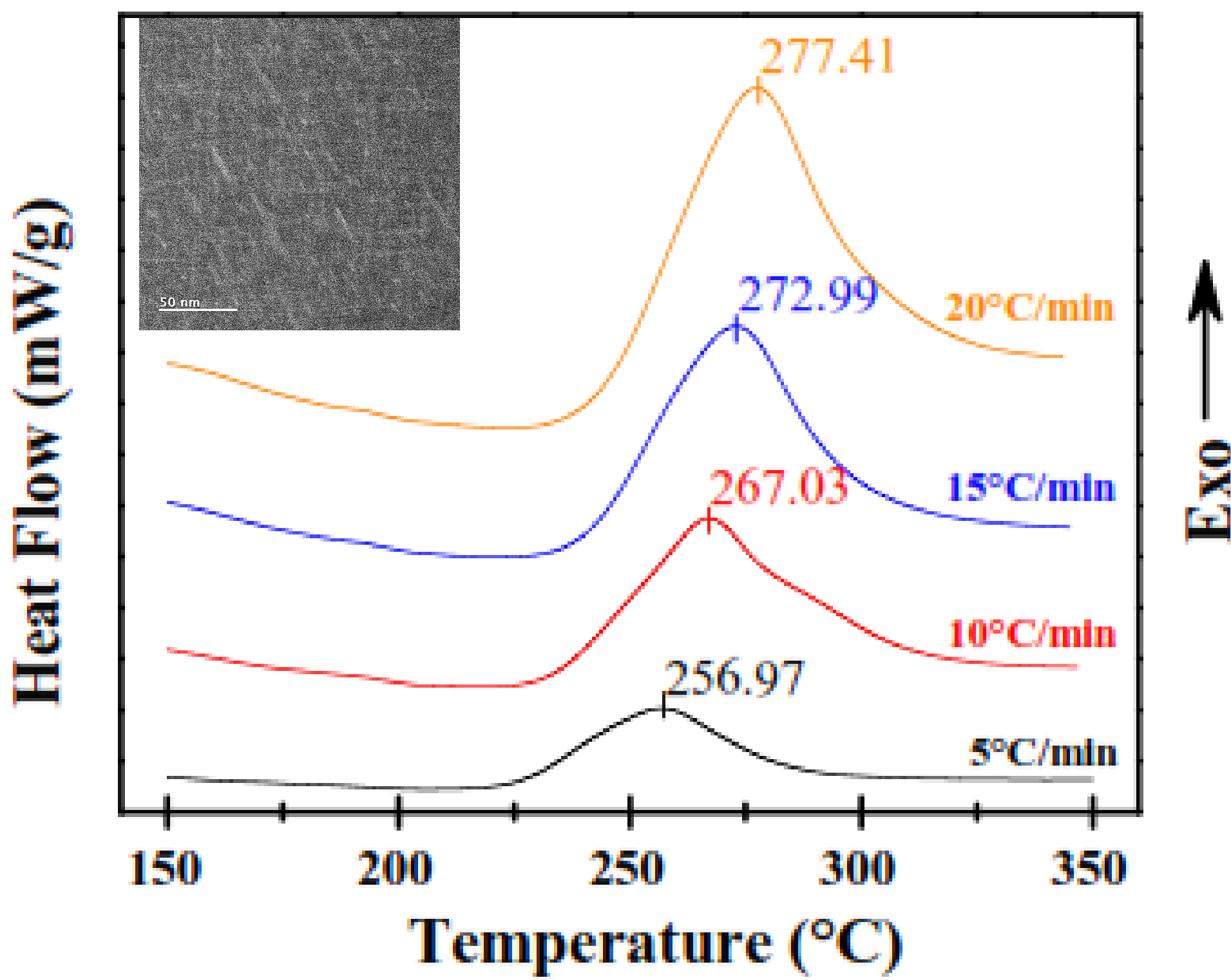
- To compare Kissinger and Ozawa crystallization models to corroborate if to exist significative differences in the activation energy of the S' phase formation to use both models.
- To establish a correlation between the effect of the cold rolled on the activation energy needed for S' phase formation. Under experimental conditions performed, this will contribute in to establish its sequence precipitation in the aging hardening process of the 2024 aluminum alloy.
- To determine the reaction order (Avrami index) for to establish the mechanism that controls the S' phase precipitation

3. METHODOLOGY

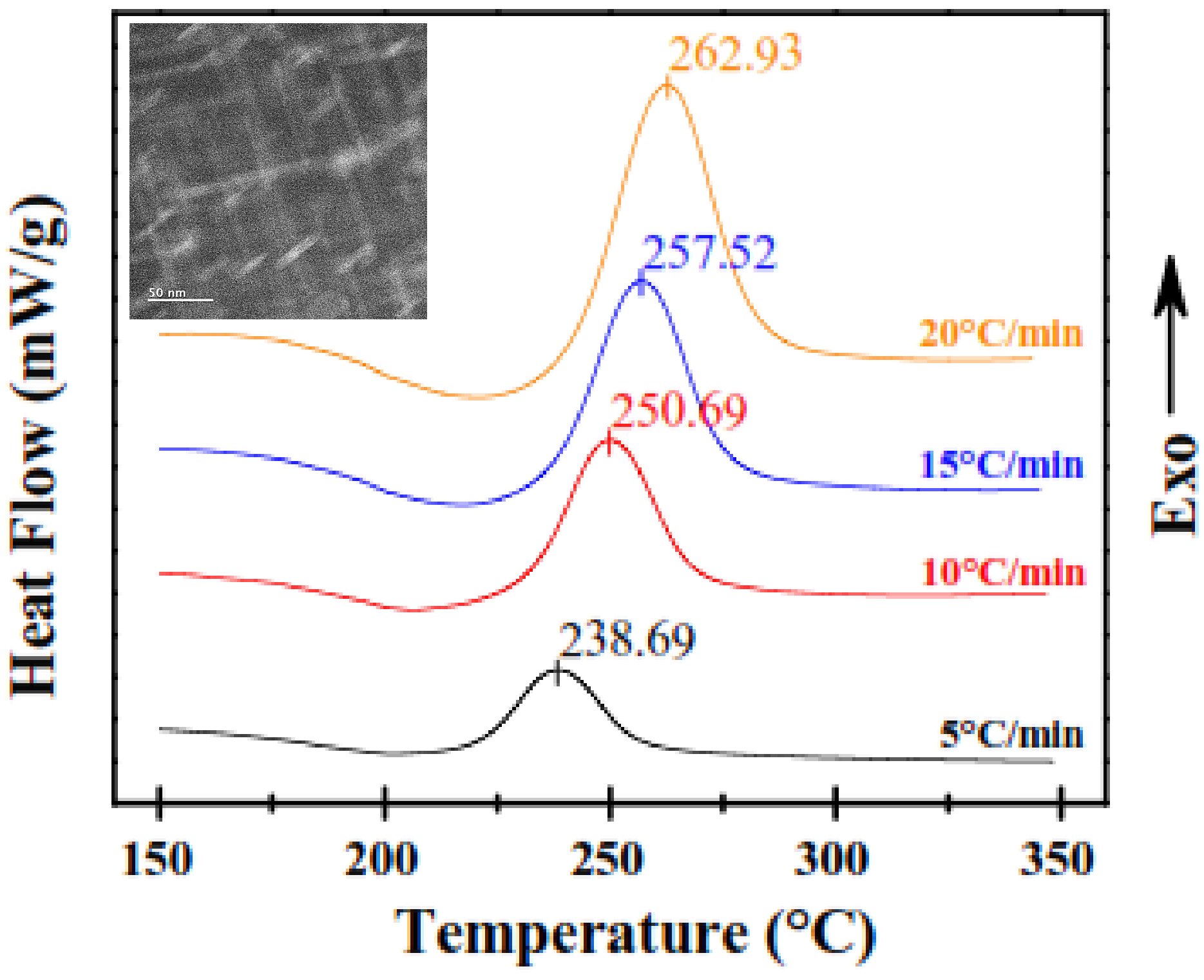


4. RESULTS

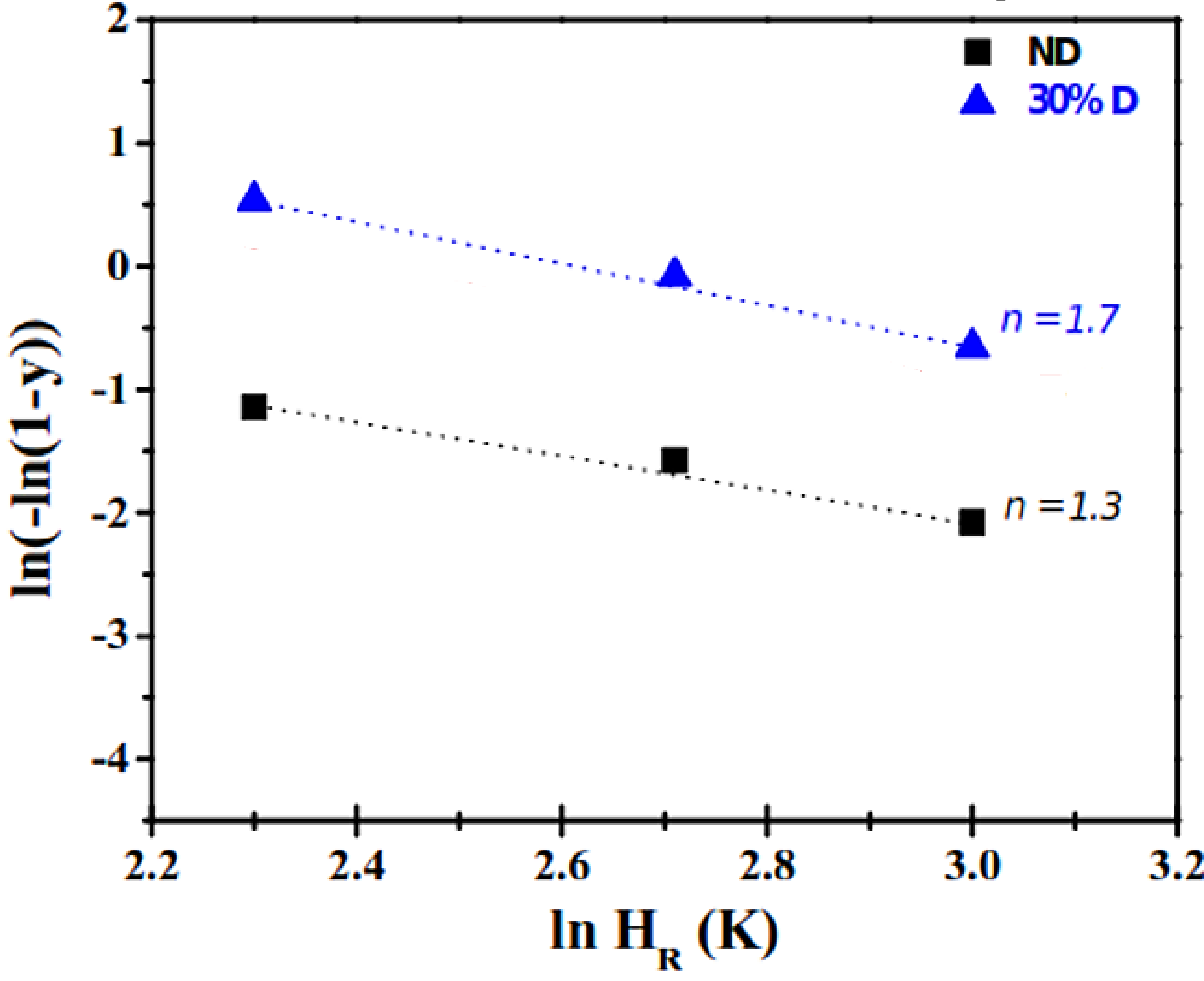
DSC thermogram of non-deformed sample



DSC thermogram of 30%ε deformed sample



Determination of Avrami index for non-deformed and 30%ε deformed sample



Summary chart of activation energy (Q, in kJ/mol) and enthalpy of formation (ΔH , in J/g) for the precipitation of S' phase.

Sample	Kissinger	Ozawa	ΔH ($H_R=20^\circ C/min$)	$\Delta H_{Average}$
ND	142.3 ± 5.8	151.2 ± 5.8	17.31	17.7
30%D	124.6 ± 3.4	133.3 ± 3.4	14.13	14.1

5. CONCLUSIONS

- The activation energy calculated by the Kissinger model is ~5% lower compared to the measurements obtained by Ozawa method. However, following both models, there is a clear trend in which the deformed samples required lower energy for precipitation.
- The deformation grade has influence in the morphology and size of the S' precipitates, which could has an important effect on the strengthening of the alloy.
- Avrami index obtained for 30% ε deformed sample ($n=1.7$) and non deformed sample ($n=1.3$) suggest that the phase transformation is controlled by diffusion.

6. ACKNOWLEDGMENTS

J.C. Guia-Tello expresses his gratitude to CONACYT (The National Council of Science and Technology of Mexico) for the posdoctoral scholarship provided. The authors are deeply grateful to Msc. Daniel Lardizabal and Dr. Ivanovich Estrada-Guel by the calorimetry analysis performed. In addition, the authors grateful to Msc. Oscar Solis-Canto and Dr. Carlos Elias-Ornelas by their valuable support in sample preparation by FIB and characterization by STEM of the Al2024 alloy, respectively.

7. REFERENCES

- Wang S.Q., Schneider M., Ye H.Q., Gottstein G., "First-principles study of the formation of Guinier–Preston zones in Al–Cu alloys", Scripta Materialia, Vol. 51, No. 7, 2004, pp. 665–669.
- Li Siyu, Zhang Jin, Yang Jinlong, Deng Yunlai , Zhang Xinming., "Influence of Mg Contents on Aging Precipitation Behavior of Al–3.5Cu–xMg Alloy", Acta Metall. Sin. (Engl. Lett.), Vol. 27, No. 1, 2014, pp. 07–114.