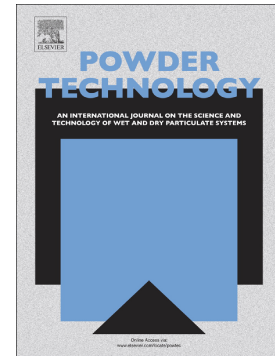


## Accepted Manuscript

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PII: S0032-5910(18)30461-3  
DOI: doi:[10.1016/j.powtec.2018.06.021](https://doi.org/10.1016/j.powtec.2018.06.021)  
Reference: PTEC 13454  
To appear in: *Powder Technology*  
Received date: 3 January 2018  
Revised date: 29 April 2018  
Accepted date: 11 June 2018

Please cite this article as: Mohammad Hossein Khazaei Feizabad, Shahriar Sharafi, Gholam Reza Khayati, Mohammad Ranjbar , Modeling of stress relaxation kinetics of amorphous Fe<sub>0.7</sub>Nb<sub>0.1</sub>Zr<sub>0.1</sub>Ti<sub>0.1</sub> alloy powder: A novel approach based on differential thermal analysis. Ptec (2017), doi:[10.1016/j.powtec.2018.06.021](https://doi.org/10.1016/j.powtec.2018.06.021)

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Modeling of stress relaxation kinetics of amorphous  $\text{Fe}_{0.7}\text{Nb}_{0.1}\text{Zr}_{0.1}\text{Ti}_{0.1}$  alloy powder: a novel approach based on differential thermal analysis

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## Abstract

In this study, the stress relaxation of amorphous  $\text{Fe}_{0.7}\text{Nb}_{0.1}\text{Ti}_{0.1}\text{Zr}_{0.1}$  alloy was investigated by differential thermal analysis (DTA) to enhance the soft magnetic properties. Amorphous  $\text{Fe}_{0.7}\text{Nb}_{0.1}\text{Zr}_{0.1}\text{Ti}_{0.1}$  alloy was produced by mechanical alloying technique using the mixture of pure elements and without adding metalloids. It was found that the stress relaxation process follows the Johnson-Mehl-Avrami model and the mechanism was volume diffusion control with three dimensional growth of the nuclei. The relation of stress relaxation progress ( $\alpha$ ), with time was proposed as:  $\frac{d\alpha}{dt} = \beta \frac{d\alpha}{dT} = 3.04 \exp\left(-\frac{4312}{RT}\right) (1 - \alpha)\{-\ln(1 - \alpha)\}^{0.37}$ . The final achieved microstructure leads to higher saturation magnetization and lower coercivity that are favorable for soft magnetic applications.

**Keywords:** Amorphous Fe based alloys; Magnetic materials; Mechanical alloying/milling; Recovery; Magnetic properties; Relaxation kinetics

## 1. Introduction

### 1.1. Amorphous Fe based alloys

The amorphous Fe based soft magnetic materials have a great interest since the first ferromagnetic amorphous material, i.e.,  $\text{Fe}_{80}\text{P}_{13}\text{C}_7$ , was discovered in 1967 [1]. Amorphous and nanocrystalline Fe based alloys not only provide good soft

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