

## An old Friend New Understanding: Phase Formation in Lead Acid Battery

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Most of the lead acid batteries are produced in the industry by the Faure process. First, a paste containing basic lead sulfates and lead monoxide are pressed on to a conductive lead grid. This assembly is then immersed in to the H<sub>2</sub>SO<sub>4</sub> solution for the formation step. In the formation step, positive electrode oxidizes to PbO<sub>2</sub> (positive active mass, PAM for short) while negative electro reduces to a spongy lead<sup>1,2</sup>. Many studies focused on different E-pH diagrams to understand the thermodynamics of the Pb/H<sub>2</sub>SO<sub>4</sub>/H<sub>2</sub>O system. Here we developed a dynamic E-pH diagram in which the equilibrium potential depends on pH, temperature and the sulfate activity. We also utilized SEM and TEM investigations to identify the characteristics morphologies of the individual PbO<sub>2</sub> polymorphs namely  $\alpha$ -PbO<sub>2</sub> and  $\beta$ -PbO<sub>2</sub>. These two polymorphs morphologies, which have orthorhombic or tetragonal crystal structures, could not be identified univocally until now. SEM images show that depending on the acid concentration PbO<sub>2</sub> morphology changes between needle-like and spherical and the starting PbSO<sub>4</sub> morphology effect's the PbO<sub>2</sub> formation mechanism and its outcome. TEM investigations could be a clear way of identification, however, the strong electron shower causes a phase transformation during prolonged analysis.

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2. Pavlov, D. *Lead-Acid Batteries: Science and Technology A Handbook of Lead-Acid Battery Technology and Its Influence on the Product Second Edition*. (Elsevier B.V., 2017).

### Biography :

Dr. Mehmet Ali Gulgun, born in Istanbul, finished his BSc degree in Mechanical Engineering at Bogazici University in Istanbul, In 1990, He received his MSc. Degree from Michigan State University (East Lansing MI) from Mechanics, Metallurgy and Materials Science Department. He graduated from University of Illinois at Urbana Champaign with a PhD Degree in Ceramic Engineering in 1996. Later he worked at Tokyo Institute of Technology Prof. Masahiro Yoshimura Laboratory, and Max Planck Institute-Stuttgart Prof. Manfred Ruhle's Group in MetallForschung. Since 2000, he works at Sabanci University as a professor of Ceramics in Materials Science and Nano Engineering program. He has three patents and over 60 SCI indexed articles. His research interests are ceramics, electron microscopy, cements and green technology.