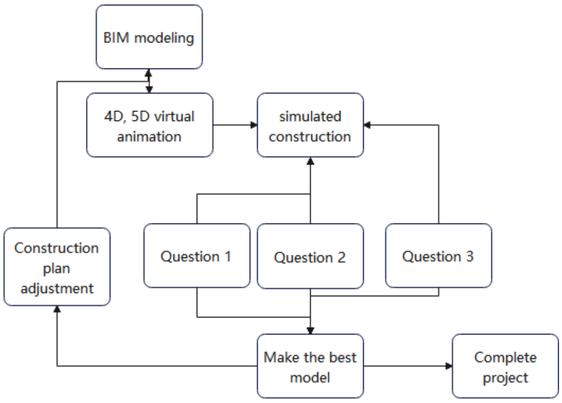

Figure 2 – BIM technology construction management flow chart

BIM technology converts two-dimensional drawings into three-dimensional real-life models using software such as Glodon, REVIT, and 3DMAX, and simulates construction through 4D and 5D virtual animations to detect construction problems, make optimal models, and adjust the original construction plan, and finally construct the 1:1 BIM optimal model, and use it to dynamically manage the construction site. And the BIM central database stores various information related to the project, including construction period, price, contract, change visa and other information, which facilitates information sharing and calling by all parties involved in the project. When the project using the BIM information model is completed, the construction personnel can obtain the project construction cost through the BIM central database, and conduct related work such as auditing the project cost and checking the project cost.

The use of BIM modeling avoids the inability to conduct final project settlement due to problems such as missing paper data and incorrect calculation of project costs. It also reduces traditional completion settlement work such as completion drawings, project visas, and design changes, improving completion efficiency , saving project construction costs. Moreover, the visualization features of BIM technology can assist project engineering quantity calibration, efficiently and accurately calculate construction costs and engineering quantities, ensure the integrity of engineering data while ensuring work efficiency, and pave the way for subsequent project construction cost work.

УДК 338

高熵合金纳米材料制备及微波催化降解性能

冯妍妍（Feng Yanyan），姚海莹（Yao Haiying）
东北大学（Northeastern University）
e-mail: 3084204770@qq.com

Summary. *Dc arc discharge plasma technology with extremely high evaporation temperature and ultra-fast cooling speed can overcome the mixing enthalpy restriction between immiscible components and obtain highly miscible high-entropy alloy nanomaterials. With the aid of external electromagnetic field, the catalytic degradation mechanism of dyes under the action of external*

electromagnetic wave energy is revealed. It provides the experimental basis and theoretical framework for the development of dye efficient degradation technology.

Organic dyes (such as methyl orange, etc.) are one of the main pollutants in industrial wastewater, which may cause serious harm to human health and ecological environment. In this regard, microwave catalytic degradation (MICD) has become a new wastewater treatment technology with its advantages of simple operation, high pollutant removal rate and environmental friendliness.

Currently, among the materials that can be used to degrade organic dyes by the MICD method, high-entropy alloy nanomaterials are preferred due to their adjustable electromagnetic compatibility and recyclability. In addition, the large specific surface area of nanoparticles can make the degradation reaction efficient and fast. The DC arc discharge plasma device developed by our research group can break through the mixing enthalpy difference limit of immiscible components, and obtain high miscible high entropy alloy nanoparticles and high entropy alloy nanobatteries with core-shell coating structure. Therefore, using the high entropy alloy nanomaterials obtained by the above-mentioned preparation process as the degradation medium, it is expected to develop an efficient organic dye degradation process with the assistance of microwave field.

In this project, the composition design and structure control of high entropy alloy nanomaterials were firstly carried out, and then the organic dye degradation was studied based on external microwave field. The specific research contents are as follows:

– firstly, high entropy alloy nanomaterials containing 5~8 elements were prepared in H2/Ar or CH4/Ar mixed atmosphere based on DC arc plasma method. Components include FeCoNiCrCu, FeCoNiMnCu, etc., and carbon-coated alloy materials;

– secondly, a solution with a methyl orange dye concentration of 20 mg/L, high-entropy alloy nanoparticles and carbon-coated alloy nanoparticles with different components and a filler volume of 1 g/L were selected as catalysts for dye adsorption experiments. The quantitative solution was taken out every 10 min, and the solution concentration was measured by UV-visible spectrophotometer to calculate the dye removal rate;

– thirdly, high entropy alloy nanomaterial was selected as catalyst, and the dye degradation test was carried out on the sample solution driven by microwave after equilibrium, and the dye degradation rate under different times of microwave catalysis was calculated. The test results of solution with methyl orange dye concentration of 20 mg/L are shown in fig. 1.

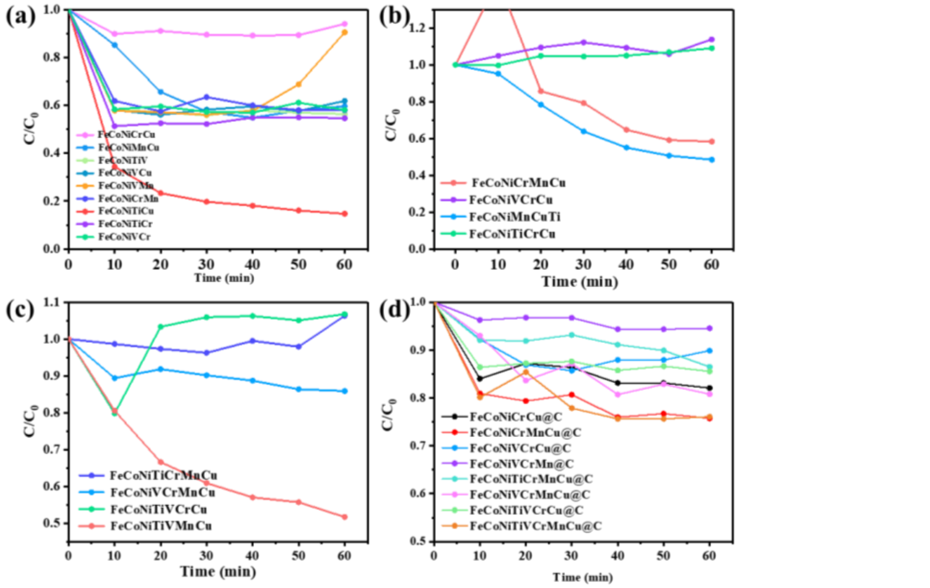

Figure 1 – Dye adsorption removal rates of high-entropy alloy nanoparticles and carbon-coated nanoparticles: *a* – 5-element alloy nanoparticles; *b* – 6-element alloy nanoparticles; *c* – 7–8 element alloy nanoparticles; *d* – Carbon coated alloy nanoparticles

It can be seen from Figure 1(A-C) that the adsorption removal rate of methyl orange dye has no obvious correlation with the number of components of the high-entropy alloy powder, but has a certain correlation with the type of components.

According to the results of adsorption removal experiments, several representative groups of high entropy alloy powders were selected for microwave-driven dye degradation experiments.

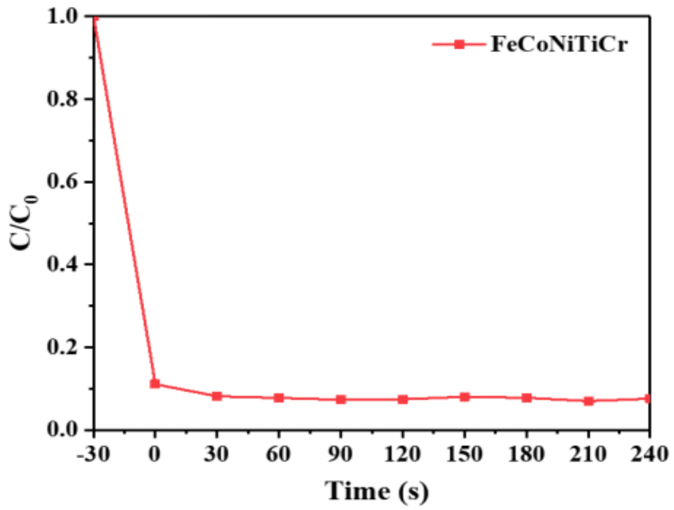

Figure 2 – Microwave catalytic degradation curve of alloy powder

A solution with methyl orange dye concentration of 10 mg/L was selected, and high entropy alloy nanomaterial was used as catalyst for microwave catalytic degradation of dye. As can be seen from fig. 2, when the composition of FeCoNiTiCr alloy powder is 20 g/L filler, the adsorption removal rate is 90 %, and after microwave catalysis, the dye removal rate is about 94 %. Subsequent analysis combined with liquid chromatography showed that the methyl orange dye had been degraded.

УДК 338

磁场下连铸过程模拟及新型磁流体制备研究

王彦强（Wang Yanqiang）
东北大学（Northeastern University）
e-mail: 2050550942@qq.com

Summary. *This study aims to simulate the flow behavior of molten steel in an electromagnetic field using magnetorheological fluid and investigate the influence of the magnetic field on the flow behavior of molten steel during continuous casting. Magnetorheological fluids exhibit good flowability and magnetic responsiveness, allowing their rheological properties to be controlled by adjusting parameters such as magnetic field strength, concentration, arrangement of magnetic particles, and direction of movement. A new type of highly transparent magnetorheological fluid was developed for this study, and optical observation using traditional water models was employed. Leveraging its transparency and non-toxicity at low temperatures, the study examined the impact of the electromagnetic field on molten steel flow behavior during continuous casting.*

Continuous steel casting, commonly referred to as continuous casting, not only improves production efficiency and product quality but also reduces costs. Furthermore, it enhances energy efficiency and sustainability by increasing steel utilization and reducing fuel consumption, thus contributing to energy savings and emissions reduction goals. Serving as a crucial element in the steelmaking process, continuous casting plays a pivotal role throughout modern steel production.

Nonetheless, several challenges persist, including internal defects in steel billets, particularly the Oxidation slag phenomenon during the initial stage of continuous casting. During the casting process, as molten steel flows from the submerged nozzle, a transition turbulent region is formed between the localized jet and the surrounding stagnant flow, leading to the formation of a hydraulic jump within the crystallizer and causing adverse effects like fluctuations in the liquid level. Therefore, this experiment aimed to investigate the formation of a circular hydraulic jump in the electromagnetic process during unsteady casting.

The research can be divided into three main parts: preparation of a novel transparent magnetorheological fluid suspension to simulate molten steel flow,