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Editorial: Surface Chemistry of Flotation

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Editorial on the Research Topic

Surface Chemistry of Flotation

Flotation, separating minerals based on the interaction between air bubbles and mineral surfaces, reigns supreme in the mining field. Since the early 20th century, flotation, especially sulfide flotation, has been a well-developed industrial technology. In the meantime, tremendous efforts have been made to reveal the underlying mechanisms of flotation. A typical flotation process contains three subprocesses: a) the collision of mineral particles and air bubbles; b) the attachment in between; and c) the spreading of the three-phase contact lines. All three subprocesses must be successfully launched to achieve satisfactory flotation.

Given that surface chemistry is one of the main surface properties, it is considered to play a key role in all flotation subprocesses. In the surface chemistry of flotation, surface hydrophobicity and morphology are mainly involved, and any approach that may modify them is of great interest in this topic, including adding reagents and grinding. There is no doubt that these approaches will remain to attract attention in the future, and some novel improvements are worth making.

Flotation reagents include collector, frother, activator, depressant, pH regulator, and redox potential regulator. Many directions are promising when it comes to developing flotation reagents, including effective reagents, low-cost reagents, and environment-friendly reagents. Take the collector as an example. Mixed collectors show promise in fully making use of single collectors. A specific collector possesses unique properties: some might perform better in intensely adsorbing on the mineral surface, while others might be more selective in collecting a target mineral. And exploring the source of collectors from natural materials, such as biochemicals, is proved to lower the operating cost effectively. Besides, it is well recognized that these chemical reagents may pose a danger to the environment, and future endeavors must be aimed at avoiding this issue. Likewise, other types of flotation reagents also follow the same train of thought.

To modify the surface morphology, grinding is a practical option. An advantage of modifying the surface morphology by grinding is that it is controllable and economical by adjusting the grinding media, equipment, and duration. Numerous reports show that the surface hydrophobicity of minerals is closely related to surface roughness. Plus, the stability of liquid films between air bubbles and mineral surfaces can vary with changing surface roughness and particle size. And the liquid film stability can serve as an indicator of floatability; that is, in cases of stable films, attaching of air bubbles on the mineral surface is difficult, rendering a low flotation recovery. Furthermore, the addition of flotation reagents in the comminution stage is becoming increasingly popular in many plants, and it turns out that flotation separation can be remarkably improved.

To better understand the mechanism, many state-of-the-art technologies have been developed and utilized. Among them, atomic force microscope is a powerful tool to reveal the interaction between air bubbles and mineral surfaces with different properties. And the instruments used to characterize the liquid film present a possibility to visualize the attachment process. At the same time, simulations are employed to explain the effect of different factors, especially when the factors are

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extremely difficult to be investigated by conducting experiments. Besides, simulations can better calculate the involved energy change and the anisotropy of minerals with complex structures. One of the hot topics is the water–liquid layer near the mineral surfaces. On the other hand, traditional approaches, such as surface potential measurement and adsorption measurements, can still provide much useful information on mineral surface modifications and relevant interactions.

To sum up, the surface chemistry of flotation has been of primary interest in mineral processing for a long time. A deep understanding here is necessary because it not only enhances the efficient utilization of natural minerals for now but also inspires the development of novel approaches that are both sustainable and low-cost, guiding the mining industry in the right direction.

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ZG is the main author of the article; JZ and PK contributed in the article editing and proofreading.

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