

Novel process towards high-valuable reusing the industrial slag

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1 INTRODUCTION

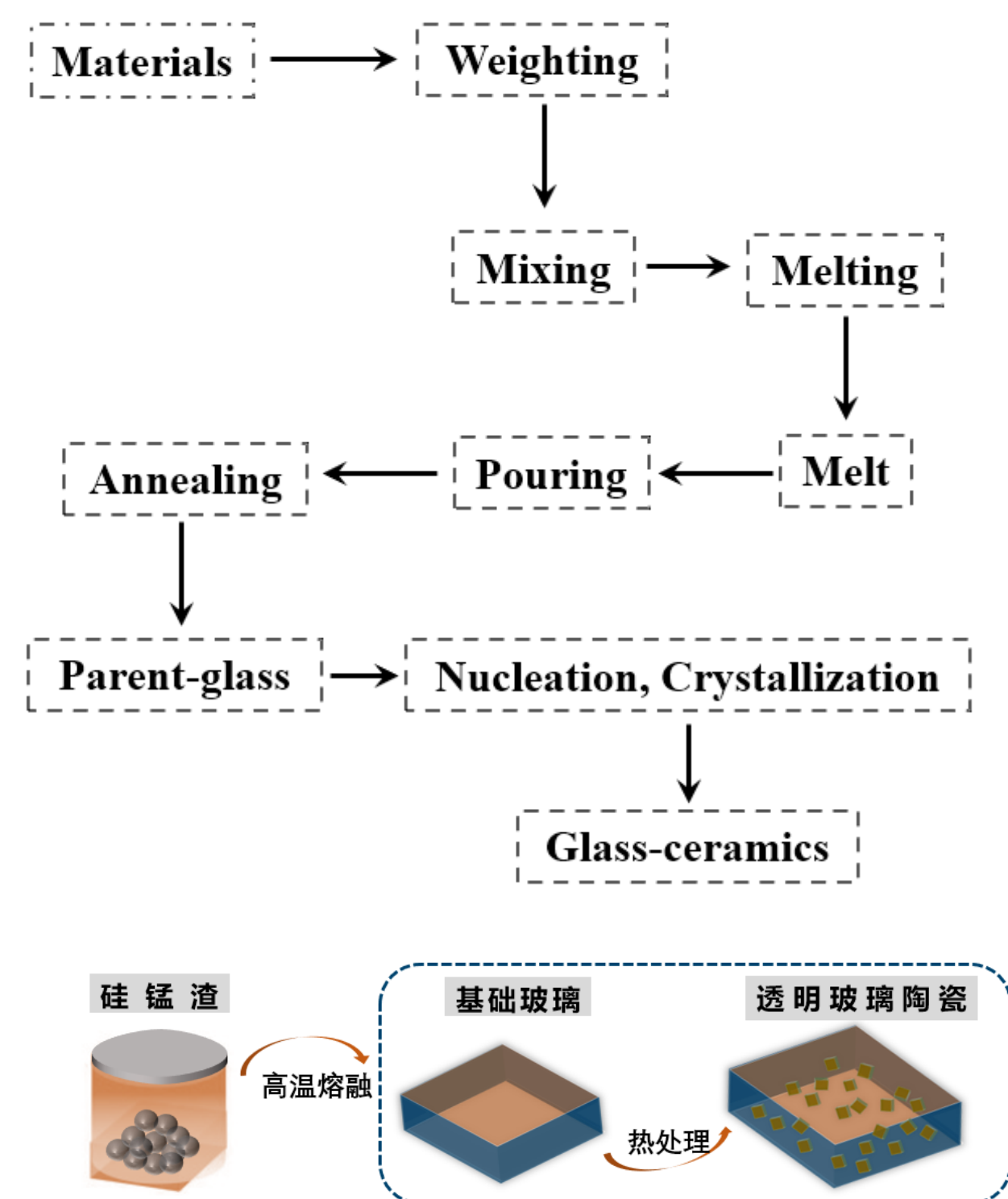
With the rapid growth of China's metallurgy industry, the production of slags like steel and non-ferrous slags has surged. However, only a small portion is recycled, with most being discarded. This not only takes up significant land but also releases harmful substances into soil and water, causing severe environmental pollution and wasting valuable resources in the slag.

Output of the metallurgical solid waste in China (Mt)

| Category | Non-ferrous slag | Ferrous metallurgy | | | |
|----------|------------------|--------------------|------------|---------------|---------------------|
| | | Blast furnace slag | Steel Slag | Iron dust mud | Ferro-alloy residue |
| Output | 128 | 240 | 100 | 60 | 14 |

In order to make fully use of the valuable resource composition in the solid waste, some new process for recycling metallurgy slags have been introduced in this work.

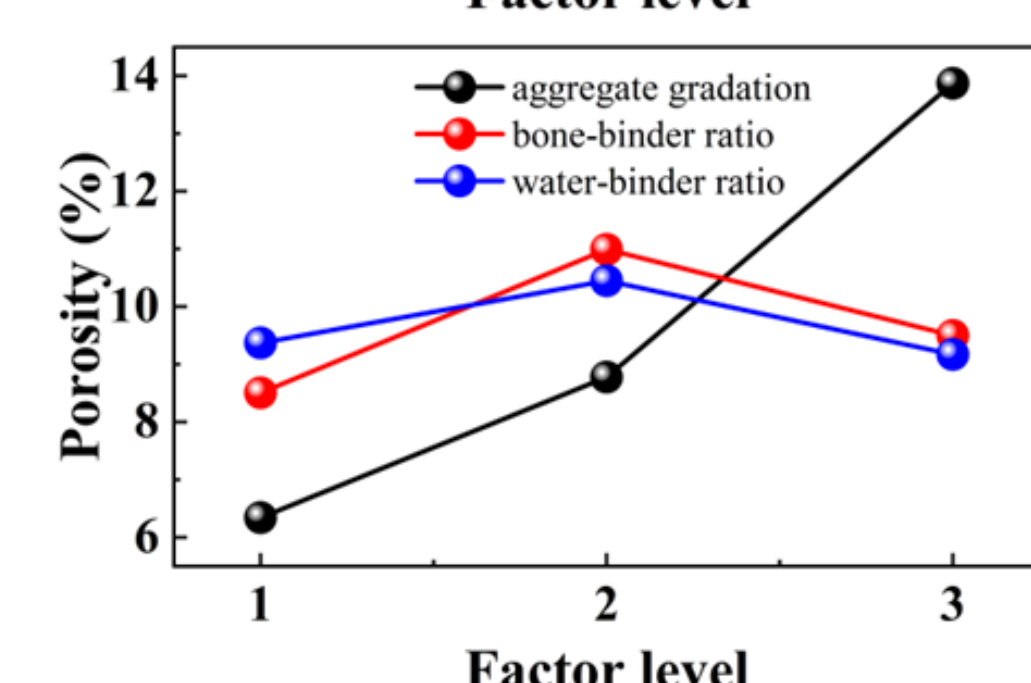
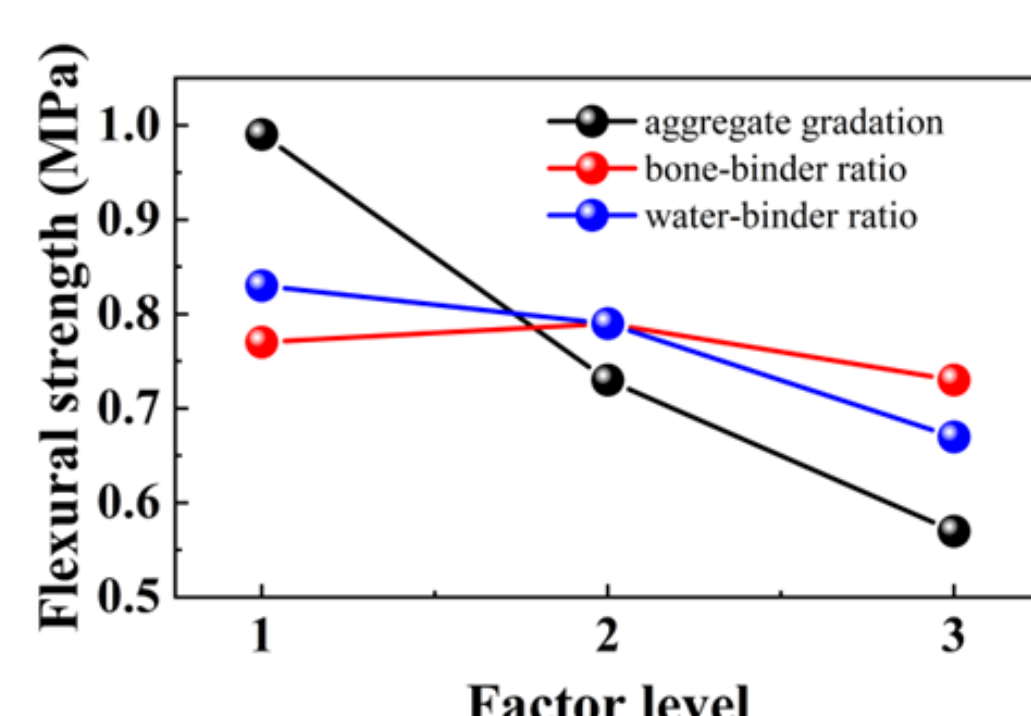
2 METHODS



- Multi-solid waste cementing material was prepared using steel slag, blast furnace slag, fly ash, and desulphurized gypsum as partial cement replacements.
- Glass-ceramics were synthesized using high carbon ferrochrome slag to evaluate mechanical properties and chromium leaching.
- Transparent glass ceramics were prepared using silicon manganese slag through high temperature melting and heat treatment. The relationship between luminescence properties and the amount of slag and treatment system was evaluated.

3 RESULTS AND DISCUSSION

◆ Multi-solid waste steel slag-Permeable bricks

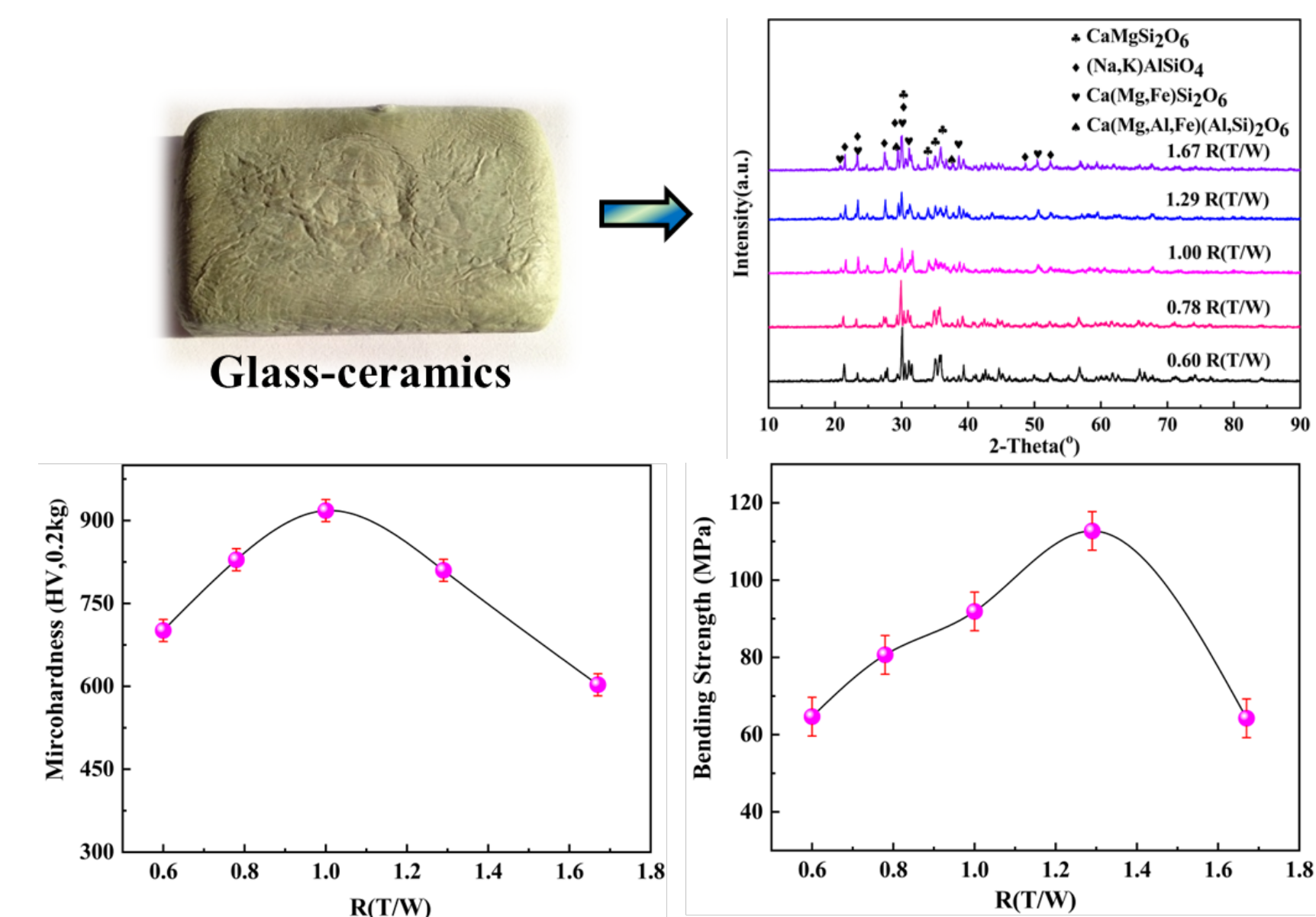


Results of spot check test

| Inspection entry | Number of samples | Average value |
|--|-------------------|---------------|
| flexural strength (MPa) | 5 | 2.9 |
| permeability coefficient (10^{-2} cm/s) | 5 | 1.2 |

Aggregate gradation is the main factor affecting the properties of permeable bricks. The prepared steel slag-free fire-resistant permeable brick has a flexural strength of 2.9 MPa and a water permeability coefficient of 1.2×10^{-2} cm/s,

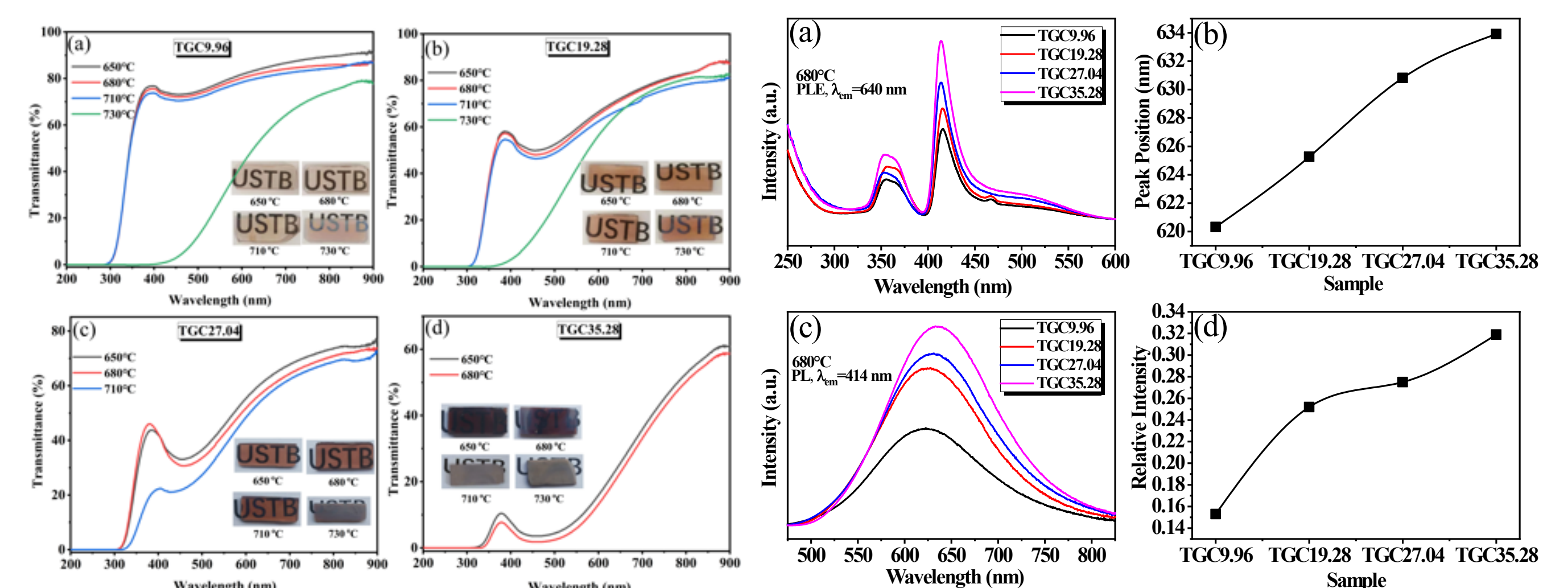
◆ Ferrochromium slag-Glass ceramics



Main phases of the glass-ceramics were diopside, nepheline, pyroxene.

The microhardness and bending strength first increase and then decrease with increase in R(T/W), the optimal bending strength and microhardness of HCFT-based glass-ceramics are 112 MPa and 9188 MPa, respectively.

◆ Silicon manganese slag-Transparent glass ceramics



The transparent glass ceramics has been prepared when heat treated during 650 °C and 710 °C for 2 h, and change to translucent state after 730 °C.

The intensity of emission peak of the glass ceramics increases with the heat treatment temperature and the slag addition.

4 CONCLUSION

- Permeable brick with improved water permeability and bending strength was successfully prepared by using a variety of solid waste cementing materials.
- Glass-ceramics from high ferrochromium slag tailings exhibit optimal bending strength (112 MPa) and microhardness (9188 MPa).
- The transparent glass ceramics made of silicon manganese residue have excellent luminescence properties.

REFERENCES

Preparation of transparent Mn-doped CaF_2 glass-ceramics from silicon-manganese slag: Dependence of colour-controllable change on slag addition and crystallization behavior[J]. Journal of the European Ceramic Society, 2020,40(8):3249-3261.
Synthesis and characterization of glass-ceramics prepared from high-carbon ferrochromium slag[J]. RSC Adv. 6 (2016): 52715-52719.