4. Conclusions

Fe-based $Fe_{50}Cr_{24}Mo_{21}Si_2B_3$ alloy powders can be prepared by high-pressure gas atomization process. The powder size decreases with increasing the mass flow rate of atomizing gas. Fe-based alloy coatings with amorphous phase was prepared by HVOF thermal spraying of gas atomized $Fe_{50}Cr_{24}Mo_{21}Si_2B_3$ powder. Microstructural studies show that the coatings present dense layered structure and extremely low porosity of 0.17% in about 200 μm thickness. The Fe-based alloy coating exhibits an average hardness about 1230 HV. Our results show that the HVOF process results in dense and well-bonded coatings, making it attractive for protective coatings applications.

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References

Chau, J.L.H., Hou, Y.Y., Pan, A.I.T. and Yang, C.C. (2017), "Fabrication of high hardness and corrosion resistance coatings from Fe-based alloy powders", *Particul. Sci. Technol.: Int. J.*, **35**(2), 209-213.

Chen, M. (2011), "A brief overview of bulk metallic glasses", *NPG Asia Materials*, **3**(9), 82-90.

Fauchais, P.L., Heberlein, J.V.R. and Boulos, M. (2014), *Thermal Spray Fundamentals: From Powder to Part*, Springer, New York, NY, USA.

Grgač, P., Behúlová, M., Moravčík, R. and Mesárošová, J. (2012), "Semi-quantitative model of the microstructure development in the high-alloyed iron based alloy during atomization", *Mater. Res.*, **15**(5), 705-712.

Guo, R.Q., Zhang, C., Chen, Q., Yang, Y., Li, N. and Liu, L. (2011), "Study of structure and corrosion resistance of Fe-based amorphous coatings prepared by HVAF and HVOF", *Corrosion Science*, **53**(7), 2351-2356.

Inoue, A. and Takeuchi, A. (2011), "Recent development and application products of bulk glassy alloys", *Acta Materialia*, **59**(6), 2243-2267.

Kobayashi, A., Yano, S., Kimura, H. and Inoue, A. (2008), "Mechanical property of Fe-base metallic glass coating formed by gas tunnel type plasma spraying", *Surf. Coat. Technol.*, **202**(12), 2513-2518.

Liu, Z.Q., Zheng, Y.G., Chang, X.C., Hou, W.L., Wang, J.Q., Tang, Z. and Burgess, A. (2009), "Microstructure and properties of Fe-based amorphous metallic coating produced by high velocity axial plasma spraying", *J. Alloys Compounds*, **484**(1-2), 300-307.

Ni, H.S., Liu, X.H., Chang, X.C., Hou, W.L., Liu, W. and Wang, J.Q. (2009), "High performance amorphous steel coating prepared by HVOF thermal spraying", *J. Alloys Compounds*, **467**, 163-167.

Nishiyama, N., Amiya, K. and Inoue, A. (2004), "Bulk metallic glasses for industrial products", *Mater. Transact.*, **45**(4), 1245-1250.

Pei, H.J., Lee, C.J., Du, X.H., Chang, Y.C. and Huang, J.C. (2011), "Tension behavior of metallic glass coating on Cu foil", *Mater. Sci. Eng. A*, **528**(24), 7317-7322.

Srivastava, R.M., Eckert, J., Löser, W., Dhindaw, B.K. and Schultz, L. (2002), "Cooling rate evaluation for bulk amorphous alloys from eutectic microstructures in casting processes", *Mater. Transact.*, **43**(7), 1670-1675.

Suryanarayana, C. and Inoue, A. (2013), "Iron-based bulk metallic glasses", *Int. Mater. Rev.*, **58**(3), 131-166.

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