Supplementary Materials

Application of Artificial Neural Network to the Prediction of Tensile Properties in High-Strength Low-Carbon Bainitic Steels

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Table S1. Multi linear regression (MLR) model for predicting the yield strength, yield-to-tensile ratio, and uniform elongation of low-carbon high-strength bainitic steels based on the fractions of microstructure constituents.

The general expression for standard MLA is given by $Y = a_0 + a_1x_1 + a_2x_2 + \cdots + a_nx_n + \varepsilon$ where Y is the dependent variable, x_i and n are independent variables, a_i are the coefficients, and ε is the random error. The MLR between constituent fractions and tensile properties was done with 20 training datasets.	
Empirical equations	Yield strength (MPa) = 1934.747 – (16.2332V_{PF} + 13.8634V_{AF} + 13.4355V_{GB} + 12.3704V_{BF}), R^2=0.5816
	Yield-to-tensile ratio = 1.138229 – (0.00246V_{PF} + 0.00286V_{AF} + 0.00439V_{GB} + 0.00365V_{BF}), R^2=0.7829
	Uniform elongation (%) = –53.506 + (0.72770V_{PF} – 0.61498V_{AF} – 0.61225V_{GB} – 0.59962V_{BF}), R^2=0.7842

Table S2. Process to calculate the index of relative importance (I_{RI}).

Number	Process
1	The % band of ith input parameter $= ((X_i)Maximum - (X_i)Minimum)/100$
2	The 6 % band of each input parameter was considered i.e., +3 % and -3 %
3	As a result, input parameter X_i has two row matrices $[+3\,\%\,X_1 + X_2 + X_3 + X_4]$ and $[-3\,\%\,X_1 + X_2 + X_3 + X_4]$
4	When these two row matrices were passed through the ANN model, $(Y_i)_{+3\%X_i}$ and $(Y_i)_{-3\%X_i}$ were predicted
5	The difference $\Delta(y_i) = (Y_i)_{+3\%X_i} - (Y_i)_{-3\%X_i}$ was calculated
6	The index of relative importance (I_{RI}) of input parameter X_i was calculated from the formula : $I_{RI} = \Delta(y_i)/((y_i)\mathrm{Maximum} - (y_i)\mathrm{Minimum})$

The process (from step 1 to step 6) was repeated to obtain the I_{RI} for the remaining input parameters. During one input parameter was varied by a ±3 % offset, the other input parameters were kept constant. After adding the ±3 % variation to all the input parameters, 12 combinations of input parameter datasets were formed. These datasets were provided to the ANN model to predict the respective output parameters and thereby to calculate I_{RI} for each input parameter.