Fig. S1. Cole-cole semicircles of as-milled FeCoNiSi$_x$Al$_{0.4}$ (a-e for $x=0.1, 0.2, 0.3, 0.4$, and 0.5) HEA powders.
Fig. S2. Cole-cole semicircles of as-annealed FeCoNiSi$_x$Al$_{0.4}$ (a-e for $x=0.1, 0.2, 0.3, 0.4$, and 0.5) HEA powders.
Fig. S3. Reflection loss of the as-milled FeCoNiSi$_x$Al$_{0.4}$ (a-e for $x=0.1$, 0.2, 0.3, 0.4, and 0.5) HEA powders in the frequency range of 2-18GHz.
Fig. S4. Reflection loss of the as-annealed FeCoNi$_x$Al$_{0.4}$ (a-e for $x = 0.1$, 0.2, 0.3, 0.4, and 0.5) HEA powders in the frequency range of 2-18GHz.
Fig. S5. Reflection loss of the as-milled (a) and as-annealed (b) FeCoNiSi$_x$Al$_{0.4}$ HEA powders for 2mm thickness. The position of absorption peaks agree with the change of dielectric constant.

Fig. S6. Reflection loss of the as-annealed FeCoNiSi$_{0.3}$Al$_{0.4}$ (a-d for 573K-873K) HEA powders in the frequency range of 2-18GHz.
Fig. S7. Reflection loss of the as-milled and as-annealed (573-873K) FeCoNiSi_{0.3}Al_{0.4} HEA powders for 2mm thickness. The position of absorption peaks agree with the change of dielectric constant.

Fig. S8. Effects of annealing temperature on the (a-b) relative complex permittivity and (c-d) complex permeability for FeCoNiSi_{0.1}Al_{0.4} alloy powders. The symbols of ■, ○, △, ▽ and □ denote the milled, 573K, 673K, 773K and 873K composites, respectively.
Fig. S9. Effects of annealing temperature on the (a-b) relative complex permittivity and (c-d) complex permeability for FeCoNiSi$_{0.2}$Al$_{0.4}$ alloy powders. The symbols of , , , and denote the milled, 573K, 673K, 773K and 873K composites, respectively.

Fig. S10. Effects of annealing temperature on the (a-b) relative complex permittivity and (c-d) complex permeability for FeCoNiSi$_{0.4}$Al$_{0.4}$ alloy powders. The symbols of
denote the milled, 573K, 673K, 773K and 873K composites, respectively.

![Graphs](image)

Fig. S11. Effects of annealing temperature on the (a-b) relative complex permittivity and (c-d) complex permeability for FeCoNiSi$_{0.5}$Al$_{0.4}$ alloy powders. The symbols of $\square$, $\square$, $\square$, $\square$, and $\square$ denote the milled, 573K, 673K, 773K and 873K composites, respectively.

Table S1. Effects of Si content on the conductivity of initial and annealed alloy powders.

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<tr>
<th>Conductivity (S/cm)</th>
<th>0.1</th>
<th>0.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
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<tr>
<td>initial</td>
<td>29.58</td>
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<td>21.98</td>
<td>10.75</td>
<td>4.88</td>
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<td>anneal-300°C</td>
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<td>22.73</td>
<td>36.27</td>
<td>12.49</td>
<td>10.24</td>
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<td>anneal-400°C</td>
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<td>97.08</td>
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<td>124.56</td>
<td>133.65</td>
<td>69.58</td>
<td>62.25</td>
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<tr>
<td>anneal-600°C</td>
<td>218.08</td>
<td>61.68</td>
<td>94.05</td>
<td>72.74</td>
<td>23.44</td>
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