WHAT IS CLAIMED IS:

1. A system, comprising:

a cathode comprising a cathode tube;

a thermionic emitter installed at least partially within the cathode tube, the thermionic emitter comprising a shape of a hollow cylinder, wherein:

the hollow cylinder comprises an outer surface and an unsmooth inner surface;

the outer surface is configured to contact an inner surface of the cathode tube;

the unsmooth inner surface comprises a plurality of structures; and

the plurality of structures of the unsmooth inner surface provide an increase in surface area over a smooth surface, wherein the plurality of structures of the unsmooth inner surface comprises:

a plurality of rectangular troughs that extend from a first end of the thermionic emitter to a second end of the thermionic emitter that is opposite the first end, each one of the plurality of troughs comprising:

a first side;

a second side that is parallel to the first side; and

a bottom edge;

a plurality of ridges that extend from the first end of the thermionic emitter to the second end of the thermionic emitter, wherein each one of the plurality of ridges is between two of the plurality of rectangular troughs; and

a heater at least partially surrounding the cathode tube, the heater configured to heat the thermionic emitter.

2. The system of Claim 1, wherein the plurality of structures of the unsmooth inner surface comprises:

a plurality of semi-circular troughs that extend from a first end of the thermionic emitter to a second end of the thermionic emitter that is opposite the first end; and

a plurality of ridges that extend from the first end of the thermionic emitter to the second end of the thermionic emitter, wherein each one of the plurality of ridges is between two of the plurality of semi-circular troughs.

3. The system of Claim 1, wherein the plurality of structures of the unsmooth inner surface comprises:

a plurality of triangular troughs that extend from a first end of the thermionic emitter to a second end of the thermionic emitter that is opposite the first end; and

a plurality of ridges that extend from the first end of the thermionic emitter to the second end of the thermionic emitter, wherein each one of the plurality of ridges is between two of the plurality of triangular troughs.

4. The system of Claim 1, wherein the bottom edge of each one of the plurality of rectangular troughs is curved.

5. The system of Claim 1, wherein:

the bottom edge of each respective rectangular trough is flat; and

the bottom edge of each respective rectangular trough is orthogonal to the first and second sides of the respective rectangular trough.

6. The system of Claim 1, wherein the thermionic emitter is formed from a material selected from the group consisting of:

tungsten;

thoriated tungsten;

lanthanum hexaboride;

barium oxide; and

cerium hexaboride.

7. A system, comprising:

a cathode comprising a cathode tube;

a thermionic emitter installed at least partially within the cathode tube, the thermionic emitter comprising a shape of a hollow cylinder, wherein:

the hollow cylinder comprises an outer surface and an inner surface; and

the inner surface comprises a plurality of structures extending below or above the inner surface, wherein the plurality of structures of the inner surface comprises:

a plurality of rectangular troughs that extend from a first end of the thermionic emitter to a second end of the thermionic emitter that is opposite the first end, each one of the plurality of rectangular troughs comprising:

a first side;

a second side that is parallel to the first side; and

a bottom edge;

a plurality of ridges that extend from the first end of the thermionic emitter to the second end of the thermionic emitter, wherein each one of the plurality of ridges is between two of the plurality of rectangular troughs; and

a heater at least partially surrounding the cathode tube, the heater configured to heat the thermionic emitter.

8. The system of Claim 7, wherein the plurality of structures of the inner surface comprises:

a plurality of semi-circular troughs that extend from a first end of the thermionic emitter to a second end of the thermionic emitter that is opposite the first end; and

a plurality of ridges that extend from the first end of the thermionic emitter to the second end of the thermionic emitter, wherein each one of the plurality of ridges is between two of the plurality of semi-circular troughs.

9. The system of Claim 7, wherein the plurality of structures of the inner surface comprises:

a plurality of triangular troughs that extend from a first end of the thermionic emitter to a second end of the thermionic emitter that is opposite the first end; and

a plurality of ridges that extend from the first end of the thermionic emitter to the second end of the thermionic emitter, wherein each one of the plurality of ridges is between two of the plurality of triangular troughs.

10. The system of Claim 7, wherein the bottom edge of each one of the plurality of rectangular troughs is curved.

11. The system of Claim 7, wherein:

the bottom edge of each respective rectangular trough is flat; and

the bottom edge of each respective rectangular trough is orthogonal to the first and second sides of the respective trough.

12. The system of Claim 7, wherein the thermionic emitter is formed from a material selected from the group consisting of:

tungsten;

thoriated tungsten;

lanthanum hexaboride;

barium oxide; and

cerium hexaboride.

13. A thermionic emitter in the shape of a hollow cylinder, the thermionic emitter comprising:

an inner surface of the cylinder;

an outer surface of the cylinder that is opposite the inner surface; and

a plurality of structures within the inner surface of the hollow cylinder, the plurality of structures comprising:

a plurality of rectangular troughs that extend from a first end of the thermionic emitter to a second end of the thermionic emitter that is opposite the first end, each one of the plurality of rectangular troughs comprising:

a first side;

a second side that is parallel to the first side; and

a bottom edge;

a plurality of ridges that extend from the first end of the thermionic emitter to the second end of the thermionic emitter, wherein each one of the plurality of ridges is between two of the plurality of rectangular troughs.