lamp emission is in the orange-red, most preferably near 570-650 nm. In one embodiment the emission has a quantum efficiency of at least 50% with respect to absorbed photons at 254 nm. In one embodiment the phosphor is doped by using a starting material selected from a manganese oxide, a manganese halide, manganese carbonate, manganese nitrate, a manganese-containing salt, manganese nitride, manganese metal, an organo-manganese compound or a manganese-containing aluminum alloy. In one embodiment the doping is incorporated in a reducing atmosphere or an oxygen-free atmosphere. In one embodiment the phosphor is processed to reduce the surface's sensitivity to water in a fluorescent lamp. In one embodiment the phosphor is processed by heating in an atmosphere of more than 90% nitrogen. In one embodiment the phosphor is processed by heating in an atmosphere wherein gas pressure is more than 1 atmosphere. In one embodiment the phosphor is processed at temperature of at least 1500° C. In one embodiment the phosphor is processed at temperature above 1700° C. In one embodiment the surface of the phosphor is post-processed in a reactive solution or vapor. In one embodiment the surface of the phosphor is processed in an acidic solution, most preferably phosphoric acid. In one embodiment the phosphor has a CIE coordinate of about X=0.60±0.05 and Y=0.37±0.05. In one embodiment the phosphor blend is combined with at least one additional phosphor to create another color of light.

The disclosed method of making a fluorescent lamp includes the steps of heating $Al_{(1-x)}M_xN$ powder under flowing nitrogen gas, adding a source of Mn, thereby producing $Al_{(1-x)}M_xN$:Mn phosphor; providing a glass envelope; providing mercury vapor, an inert gas, and the $Al_{(1-x)}M_xN$:Mn phosphor within the glass envelope, and providing at least two electrodes connected to the glass envelope to produce the fluorescent lamp. In one embodiment the $Al_{(1-x)}M_xN$ is doped with manganese. In one embodiment the powder is deposited onto the surface of the glass envelope. In one embodiment the phosphor is post-processed by heating in air or oxygen at a temperature above room temperature, preferably above 500° C. In one embodiment the phosphor is combined with at least one additional phosphor to create another color of light.

Although the description above contains many details and specifics, these should not be construed as limiting the scope of the application but as merely providing illustrations of some of the presently preferred embodiments of the apparatus, systems, and methods. Other implementations, enhancements and variations can be made based on what is described and illustrated in this patent document. The features of the embodiments described herein may be combined in all possible combinations of methods, apparatus, modules, systems, and computer program products. Certain features that are described in this patent document in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination. Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. Moreover, the separation of various system components in the embodiments described above should not be understood as requiring such separation in all embodiments.

Therefore, it will be appreciated that the scope of the present application fully encompasses other embodiments which may become obvious to those skilled in the art. In the claims, reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." All structural and functional equivalents to the elements of the above-described preferred embodiment that are known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the present claims. Moreover, it is not necessary for a device to address each and every problem sought to be solved by the present apparatus, systems, and methods, for it to be encompassed by the present claims. Furthermore, no element or component in the present disclosure is intended to be dedicated to the public regardless of whether the element or component is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. 112, sixth paragraph, unless the element is expressly recited using the phrase "means for."

While the apparatus, systems, and methods may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the application is not intended to be limited to the particular forms disclosed. Rather, the application is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the application as defined by the following appended claims.

The claims are:

1. A fluorescent lamp, comprising:

a glass envelope;

at least two electrodes connected to said glass envelope;

mercury vapor and an inert gas within said glass envelope; and

a phosphor blend within said glass envelope, wherein said phosphor blend includes $Al_{(1-x)}M_xN$, where M may be comprised of one or more dopants drawn from beryllium, magnesium, calcium, strontium, barium, zinc, scandium, yttrium, lanthanum, cerium, praseodymium, europium, gadolinium, terbium, ytterbium, bismuth, manganese, silicon, germanium, tin, boron, or gallium and x has a value of $0<x<0.1$.

2. The fluorescent lamp of claim **1** wherein said $Al_{(1-x)}M_xN$ is doped with at least M=manganese; wherein x has the value of $0<x<0.1$.

3. The fluorescent lamp of claim **1** wherein said $Al_{(1-x)}M_xN$ contains between about 0.001% and 10% manganese.

4. The fluorescent lamp of claim **1** wherein said $Al_{(1-x)}M_xN$ is in the form of a powder with grains in the 0.1-50 micron range.

5. The fluorescent lamp of claim **4** wherein said powder is deposited onto the surface of the lamp envelope.

6. The fluorescent lamp of claim **1** wherein said $Al_{(1-x)}M_xN$ phosphor is doped with carbon and/or oxygen, together with manganese by processing conditions or addition of dopants to induce an absorption at 254 nm and emission in at least a portion of the spectral region visible to the human eye.

7. The fluorescent lamp of claim **6** wherein said emission is in the orange-red, most preferably near 570-650 nm.

8. The fluorescent lamp of claim **6** wherein said emission has a quantum efficiency of at least 50% with respect to absorbed photons at 254 nm.

9. The fluorescent lamp of claim **1** wherein said phosphor is doped by using a starting material selected from a manga-