CLAIMS

1. A method of detecting the presence or absence of a target nucleic acid in a sample, the method comprising,
    a. combining a solution comprising target nucleic acid or suspected to comprise target nucleic acid with amplification reagents to amplify the target nucleic acid if present, the amplification reagents comprising a signal primer comprising an electrochemically detectable label and a nucleic acid sequence complementary to at least a portion of said target nucleic acid thereby being capable of hybridizing to the target nucleic acid;
    b. amplify the target nucleic acid to produce a double stranded labeled amplicon if the target nucleic acid is present;
    c. incubating the double stranded labeled amplicon with exonuclease to form a single stranded labeled amplicon;
    d. hybridizing the single stranded labeled amplicon with a first capture probe; and
    e. detecting the presence or absence of the target nucleic acid in the sample using electrochemical detection.
2. The method of claim 1, wherein the signal primer, double stranded labeled amplicon, and/or single stranded labeled amplicon comprises at least one label selected from the group consisting of ferrocene, methylene blue or osmium.
3. The method of any one of claims 1 to 2, wherein the signal primer comprises a ferrocene label on the 5’-end, on any one nucleotide of nucleotides 1 to 3 at the 5’-end, on the 3’-end, on any one nucleotide of nucleotides 1 to 3 at the 3’-end or on both, the 5’- and the 3’-end or

    wherein the signal primer comprises a ferrocene label internal to the signal primer.
4. The method of any one of claims 1 to 3, wherein the signal primer, double stranded labeled amplicon, and/or single stranded labeled amplicon comprises a plurality of ferrocene labels at at least two locations.
5. The method of any one of claims 1 to 4, wherein the single stranded labeled amplicon comprises a first section capable of hybridizing to the first capture probe, a second section that is not capable of binding to the capture probe and a third section comprising the at least one label.
6. The method of any one of claims 1 to 4, wherein the signal primer comprises a first section capable of hybridizing to the first capture probe, a second section comprising a linker and a third section comprising the at least one label, wherein the linker connects the first section and

the third section.

7. The method of any one of claims 1 to 6 further comprising separating the signal primer and the single stranded labeled amplicon prior to electrochemical detection or

further comprising separating the signal primer and the double stranded labeled amplicon prior to electrochemical detection.

8. The method of any one of claims 1 to 7, wherein the signal primer consists of a first section capable of hybridizing to the capture probe, and a second section comprising the at least first label.

9. A method of detecting the presence or absence of a target nucleic acid in a sample, the method comprising,

   a. receiving a sample;
   b. extracting nucleic acids from the sample, wherein the nucleic acids are suspected of comprising target nucleic acid;
   c. combining the nucleic acid with amplification reagents to amplify the target nucleic acid if present, the amplification reagents comprising a signal primer comprising an electrochemically detectable label and a nucleic acid sequence complementary to at least a portion of said target nucleic acid thereby being capable of hybridizing to the target nucleic acid;
   d. amplify the target nucleic acid to produce a double stranded signal amplicon if the target nucleic acid is present;
   e. incubating the double stranded signal amplicon with exonuclease to form a single stranded signal amplicon;
   f. hybridizing the single stranded signal amplicon with a first capture probe; and
   g. detecting the presence or absence of the target nucleic acid in the sample using electrochemical detection.

10. The method of claim 9, wherein the signal primer comprises at least one label selected from the group consisting of ferrocene, methylene blue or osmium.

11. The method any one of claims 9 to 10, wherein a first portion of the single stranded signal amplicon binds the first capture probe and a second portion of the single stranded signal amplicon binds a second capture probe.

12. A method for detecting the presence of a single-stranded or double-stranded target nucleic acid of interest in a sample, said method comprising the steps of:

a. providing
   i. a sample suspected of containing said target nucleic acid of interest;
   ii. a signal primer that comprises:
      1. a nucleic acid sequence complementary to at least a portion of said target nucleic acid of interest, and
      2. a first electrochemically detectable label;
   iii. reagents for carrying out nucleic acid strand extension;
b. forming a reaction mixture comprising (i), (ii), and (iii) above;
c. contacting under hybridization conditions the signal primer with the target nucleic acid of interest if present;
d. extending the signal primer, thereby incorporating the electrochemically detectable label into an amplicon to form an electrochemically labeled amplicon if said target nucleic acid of interest is present;
e. denaturing the electrochemically labeled amplicon;
f. hybridizing the electrochemically labeled amplicon with a capture probe bound to an electrode surface;
g. detecting the presence of the target nucleic acid of interest by detecting energy transfer between the electrochemically labeled amplicon and the electrode surface.

13. The method of claim 12, wherein the electrochemically detectable label is selected from the group consisting of ferrocene, methylene blue or osmium.

14. The method of any one of claims 12 to 13, wherein the signal primer comprises a first portion that binds to the capture probe and a second portion that does not bind to the capture probe.

15. The method of any one of claim 12 to 14, wherein the signal primer further comprises a second electrochemically detectable label and wherein the first electrochemically detectable label and the second electrochemically detectable label are different.