[**0031**] Turning to the upper portion **8** of this embodiment of the invention, reference layer **42**, exchange layer **46**, and pinned layer **50** may be composed of the same or similar materials and fabricated in the same or a similar manner as pinned layer **18**, exchange layer **22**, and reference layer **26** in the lower portion **4** of this embodiment of the invention. Reference layer **42**, exchange layer **46**, and pinned layer **50** of the upper portion **8** of this embodiment of the invention function in a similar or the same manner as those in the lower portion **4** of the stack **2** with the magnetic orientation of pinned layer **50** being set by antiferromagnetic layer **54**. Here again, antiferromagnetic layer **54** may be composed of the same or similar materials as antiferromagnetic layer **14** in the lower portion **4** of the stack **2**.

[**0032**] THE CAP LAYER

[**0033**] The cap layer **58** functions to structurally protect the stack **2** both during fabrication and during operation. During fabrication, the various layers of the stack **2** may be subjected to oxidation and corrosion. Further, once fabricated, the stack **2** may be subjected to physical contact. The cap layer of the invention functions to protect the stack **2** of the invention against these concerns.

[**0034**] Generally, the cap layer **58** is nonmagnetic so as not to affect the electromagnetic operation of the stack **2**. In accordance with the invention the use of several preferred materials provides a cap layer **58**, which not only enhances device performance but also physically protects the stack **2** before, during and after processing. Preferably, the cap layer **58** reduces corrosion, oxidation and enhances the scattering of electrons.

[**0035**] To this end, the cap layer **58** may comprise one or more layers, preferably either a monolayer or a bilayer. In one preferred embodiment, a monolayer of tantalum nitride may be used as a cap layer **58**. Generally, the ratio of tantalum to nitride in the cap layer **58** ranges from about 30:70 to 70:30, and preferably is about 50:50. The thickness of the cap layer **58** ranges from about 20 to 200 angstroms and preferably is 50 to 70 angstroms.

[**0036**] In a second preferred embodiment, the cap layer **58** may be a bilayer of tantalum nitride with a second layer of copper, ruthenium, gold, or silver. In this embodiment, the thickness of the tantalum nitride layer generally ranges from about 20 to 200 angstroms, and preferably from about 50 to 70 angstroms. The second layer of the bilayer ranges in thickness from about 3 to 20 angstroms, and preferably about 5 to 10 angstroms. The cap layer **58** may be sputter deposited to a thickness of about **20** to **220** angstroms, preferably about 60 angstroms.

[**0037**] In either embodiment, the materials are preferably sputter deposited at ambient temperatures in a nitrogen/noble gas atmosphere. The amount of nitrogen in the atmosphere depends on the particular ratio of tantalum to nitride that is desired. Preferably, the nitrogen has a partial pressure of about 0.6 mTorr at a total pressure of about 4 mTorr. The sputter power uses ranges of about 50 W to 500 W, and preferably about 100 W.

[**0038**] Once the cap layer **58** is deposited, the stack **2** of the invention may then be annealed if desired or necessary. Any known process of annealing may be utilized to fabricate a device **2** of the invention. The step of annealing is undertaken while a magnetic field of greater than about 0.5 Tesla, preferably about 1 Tesla, is applied. Preferably, the annealing is done at a temperature of about 230° C. to about 350° C. for about 1 to 10 hours.

[**0039**] A further exemplary embodiment of the invention may be seen in **FIG. 2**. This embodiment of the invention is a bottom pinned spin valve sensor using cap layer **58**. This stack **2**' uses antiferromagnetic layer **14** to fix or pin the direction of the magnetic field in layer **18**. Pinned layer **18** then works in conjunction with exchange layer **22** and reference layer **26** in the same manner as described earlier. Free layer **34** is insulated from the pinned **18** and reference **26** layers by spacer layer **30**.

[**0040**] Another exemplary embodiment of the invention is illustrated in **FIG. 3**, which depicts a top pinned spin valve (TSV) sensor **2**" using cap layer **58**. In this embodiment, the free layer **34** is a bilayer of cobalt-iron and nickel-iron, which is insulated from the pinned **50** and reference **42** layers by spacer layer **38**. In this instance, the magnetic field of the pinned layer **50** is fixed by the antiferromagnetic layer **54**, which is positioned below cap layer **58**. Both of these embodiments perform similarly with a cap layer **58** in accordance with the invention deposited.

Working Examples

[**0041**] The following experimental examples illustrate the properties and application of the invention.

[**0042**] Example 1: Properties of spin valves with different cap layers

[**0043**] A set of six spin valve stacks were prepared such as those shown in **FIG. 2** using the processes of the invention. The cap layers varied across the six stacks as follows:

Stack	Cap Layer Material
1	nickel-iron-chromium
2	tantalum
3	nickel-iron-chrome/tantalum nitride
4	copper/tantalum
5	tantalum nitride
6	copper/tantalum nitride

[**0044**] **FIG. 4** shows the DR/R and DR of stacks **1** through **6**. Stacks **5** and **6** have DR/R that is greatly increased (by more than 15%) when compared to stack **1**. Stacks **5** and **6** also have a DR/R ratio that is 40% greater than the stack capped with nickel iron chromium (Stack **1**). As can be seen in **FIG. 5**, Stack **6**, a stack in accordance with the invention, has the smallest interlayer coupling field, while stack **2** (a stack as seen in the prior art) has the largest interlayer coupling field.

[**0045**] Example 2: Response of BSV and DSV with cap layers of the invention

[**0046**] A bottom pinned spin valve using a platinum manganese pinned layer capped with copper/tantalum nitride provided a cap layer with superior protective properties against oxidation and corrosion during fabrication. **FIG. 6** shows DR/R versus the applied field (oriented parallel to the pinned field) for this bottom spin valve (BSV) sensor with a copper/tantalum nitride cap layer.